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SERIES 200-M FLOPPY DISK DRIVE MAINTENANCE MANUAL

INNOVEX
Originators of the DISKETTE

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SERIES 200-M FLOPPY DISK DRIVE MAINTENANCE MANUAL

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SECTION I
INTRODUCTION

1-1 PURPOSE AND SCOPE.

This manual is intended for OEM Users of the INNOVEX Series 200[1] Floppy Disk Drive who have the technical background to maintain, troubleshoot and repair the unit when installed in their system or sub-system. Four Sections are contained in this manual providing the User with maintenance-type information to adequately understand the theory of operation of the Series 200[1] Disk Drive, including specifications, removal, replacement, alignment and troubleshooting procedures.

The four sections presented in this manual are as follows:

Section I - Introduction
Section II - Functional Description
Section III - Maintenance and Theory
Section IV - System Logic Diagrams

Additional, applications-type information may be found in the Series 200 OEM Manual available from INNOVEX.

1-2 GENERAL INFORMATION.

The Model 210 Drive consists of an aluminum casting which houses a Diskette Drive Motor, Track Access Stepping Motor (Head Position Actuator), Head Loading Mechanism, Read/Write Head, Hinge-Mounted Electronics Printed Circuit Board and a Front Panel/Bezel. It can be installed in virtually any orientation including rack and table-top mounting as follows:

Rack-Mounted

- Vertical with slides on top and right-hand opening access door.
- Vertical with slides on top and left-hand opening access door.
- Horizontal with door opening upwards.

Table-Mounted

- Bezel flat with door opening away from operator.
- Bezel flat with door opening towards operator.
- Bezel at an angle with door opening away from operator.
- IBM 3740 Configuration.

Optional mounting kits are available for the orientations listed above. The kits include slides, brackets, end trim, panels, counter springs and installation drawings.

Overall external dimensions are 9-inches high, 4-3/8 inches wide and 14¼-inches deep. With a Bezel and optional mounting hardware height is increased to 10½-inches. The Drive weighs 16 pounds and operates in an environment with ambient temperature between 50 and 100°F. with 8 to 80% relative ambient humidity. Access to all internal components except the drive belt and pulleys is provided by simply opening the hinged-pc board cover with the Drive installed and operating.

1-3 DISKETTES

The Model 210 Disk Drive reads and writes data on IBM or equivalent Diskettes interchangeably with IBM 3741, 3742, 3747 or 3540 Terminals. The Model 220 Drive reads and writes on Diskettes having the same dimensions but incorporates 32 holes plus an Index hole. These holes are located at the same radius (1.5 inches) as the Index hole on IBM Diskettes which consist of a flat Mylar[2] disk enclosed in a protective plastic envelope measuring 8-inches by 8-inches by 1/16-inch thick. Figure 1-2 illustrates the significant dimensions of the Diskette and Table 1-3 summarizes the characteristics.

(1) Model 210 is used throughout this manual as representative of Series 200 Disk Drive.

(2) Trademark Dupont Corp.

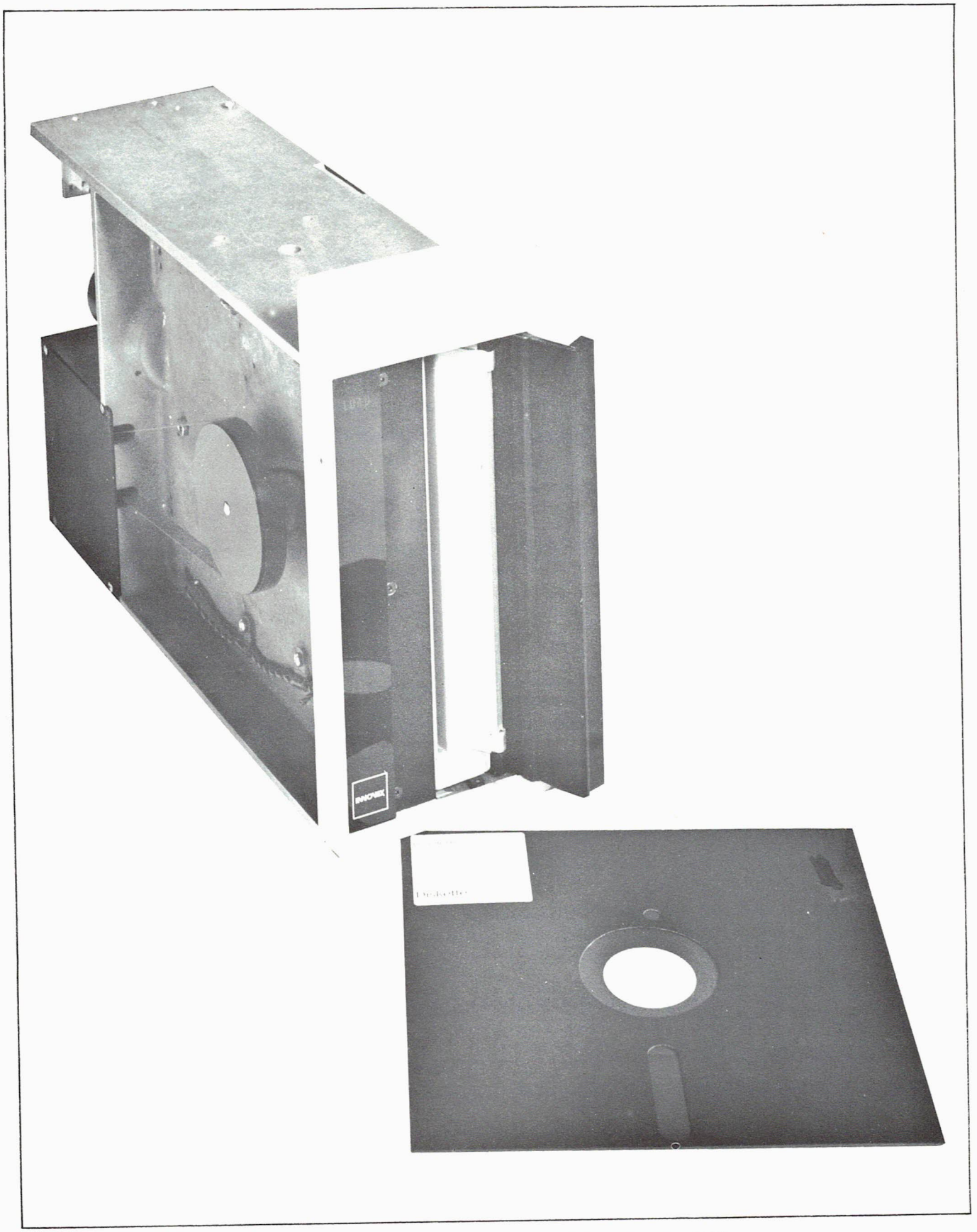

FIGURE 1-1 MODEL 210 DISK DRIVE EXTERNAL VIEW

TABLE 1-1 MECHANICAL CHARACTERISTICS

Ambient Operating Temperature	50°F to 100°F
Ambient Operating Humidity	8 to 80% with maximum wet bulb temperature of 85°F
Heat Dissipation	270 BTU/Hour
Weight	16-pounds
Height	9-inches
Height (with Bezel and optional mounting hardware)	10½-inches
Width	4-3/8-inches
Depth	14¼-inches

TABLE 1-2 ELECTRICAL AND PERFORMANCE CHARACTERISTICS

Input AC Power	
*Model No.	Voltage
210/220	95-127VAC, 60Hz @ .27 amps nom.
211/221	195-264VAC, 50Hz @ .16 amps nom.
212/222	88-127VAC, 50Hz @ .31 amps nom.
Input DC Power	+5V ± 0.25V @ 800 MA, 50 MV ripple −5V ± 0.25V @ 75 MA, 50 MV ripple +24V ± 2.0V @ 1.4A, 100 MV ripple
Rotation Speed	360 RPM ± 1%
Recording Method	Double Frequency
Capacity (unformatted)	
Per Track	41,254 bits
Per Diskette	3,170,000 bits
Density	
Bit Density (inner track)	13,262 Flux Reversals/Radian (3268 bits/inch)
Number of Tracks	77
Track Density	48 tracks/inch
Transfer Rate	250,000 bits/sec.
Access Time	
Track to Track	10 milliseconds
Settling Time	10 milliseconds
Latency (Average)	83 milliseconds
Head Load Time	30 milliseconds
Head Life	Greater than 6000 hrs. under normal operating conditions on INNOVEX approved Diskettes.

*Model 210 Series; IBM Compatible
Model 220 Series; Hard Sector

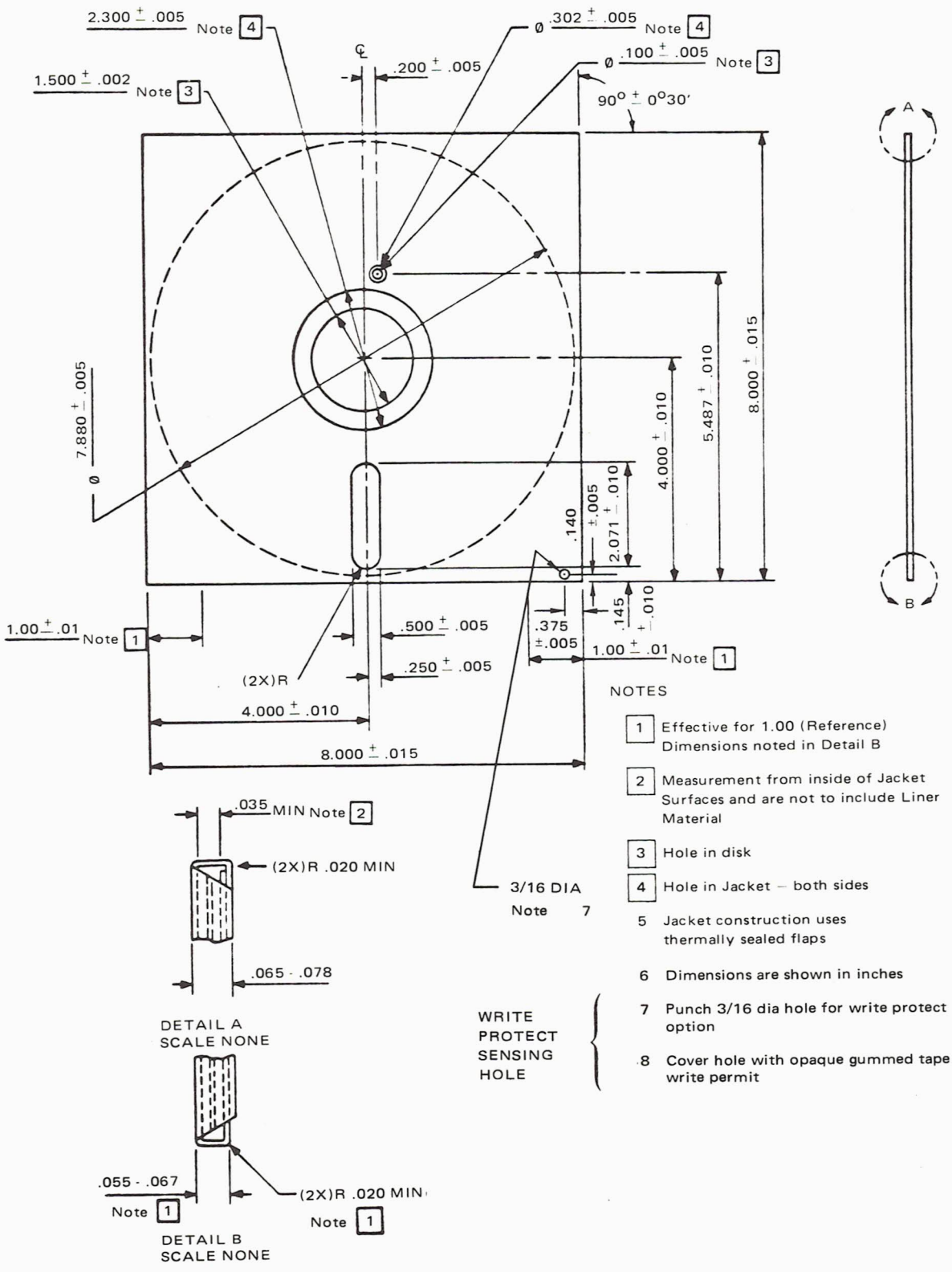

FIGURE 1-2 INNOVEX DISKETTE DIMENSIONS

TABLE 1-3 DISKETTE CHARACTERISTICS

Supplier	INNOVEX, * IBM or equivalent
Disk Diameter	7.880 ± 0.005-inches
Envelope Size	8 x 8 x 1/16-inches
Rotational Speed	360 RPM ± 1%
Rotational Period	166.67 msec. ± 1.67 msec.
Average Latency	83.33 msec.
Number of Tracks	77
Bit Density (Inside Track)	3268 bits/inch
Number of Bits/Track	41,254
Index/Sector Pulse Width	0.5 msec. (approximately)

*INNOVEX will supply a list of other qualified vendors.

1-4 LOADING PROCEDURE.

The Diskette is a flexible disk (floppy disk) enclosed in a plastic jacket. The inside of the jacket is lined with wiping cushions which clean foreign particles from the disk as it spins. Cut-outs are provided in the jacket to facilitate attachment of the disk to the drive spindle and to allow the Read/Write head to come into contact with the disk. The disk may be loaded or removed with all power on and the drive spindle rotating. To load the disk, refer to Figure 1-3 and proceed as follows:

(1) Open front door.

(2) Hold the disk as shown in Figure 1-3 with the label and jacket cut-outs facing to the right side (for vertically oriented drives).

(3) Slide the disk through the insertion slot until a firm stop is encountered.

(4) If the LOAD lamp remains illuminated, repeat steps (2) and (3) and insure the disk is completely inserted into the drive.

NOTE

If the disk is not fully inserted, the front panel LOAD lamp remains illuminated.

(5) Close front door.

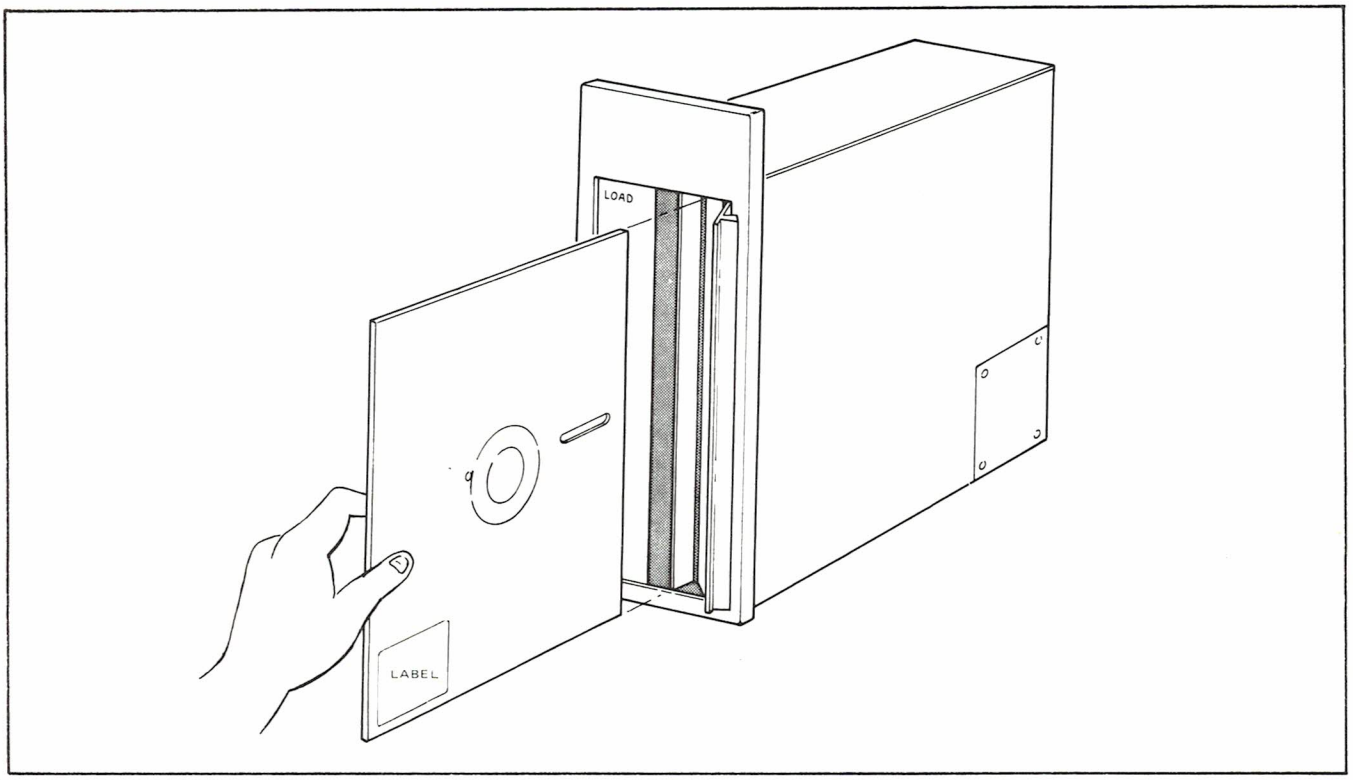

FIGURE 1-3 DISK LOADING PROCEDURE

1-5 INTERFACE CONNECTORS. (See Figure 1-4)

Signal and DC power connections to the Model 210 Drive are made with an edge connector on the printed circuit card labeled PØ2. AC power and frame ground are provided through a separate 3-pin mate and lock connector labeled PØ4.

Recommended mating connector for PØ2 is an Amphenol Twin Leaf Printed Circuit Edge Connector Part No. 583859-3 using Amphenol contacts Part No. 1-583616-1 or equivalent. The pins on the pc card connector are labeled L1 through L22 on the component side of the pc card and R1 through R22 on the other side. A polarizing notch is provided between pins 2 and 3.

The 3-circuit AC power connector is mounted on the rear of the Model 210 housing. It is an Amphenol type, Part No. 1-480305-0 using Amphenol pins, Part No. 60620-1. Recommended mating Amphenol socket is Part No. 1-480303-0 with Amphenol pins, Part No. 60619-1.

(Provision is made for the installation of a separate six-pin DC power connector PØ6. The recommended connector is AMP pin header assembly 1-380999-0 which mates with AMP socket housing 1-480270-0.

1-6 INTERFACE CIRCUITS

Two similar interface circuits are provided by the Series 200 Drive to transmit and receive:

(1) Data Signals
(2) Control Signals

These circuits are designed to interface the Series 200 with data lines having approximately a 100 ohms characteristic impedance and control lines having approximately a 150 ohms characteristic impedance.

Drivers are of an open collector type to permit a number of drivers to be connected to the same I/O bus. All Series 200 drives are equipped with receiver termination resistors. It is necessary that only the last drive on a I/O bus be terminated. This can be conveniently achieved by means of 8 cavity Bussco Bus Strip No. B5153-100-8G to connect together all the pins of the pin header PØ7 on the printed circuit board of the terminating drive.

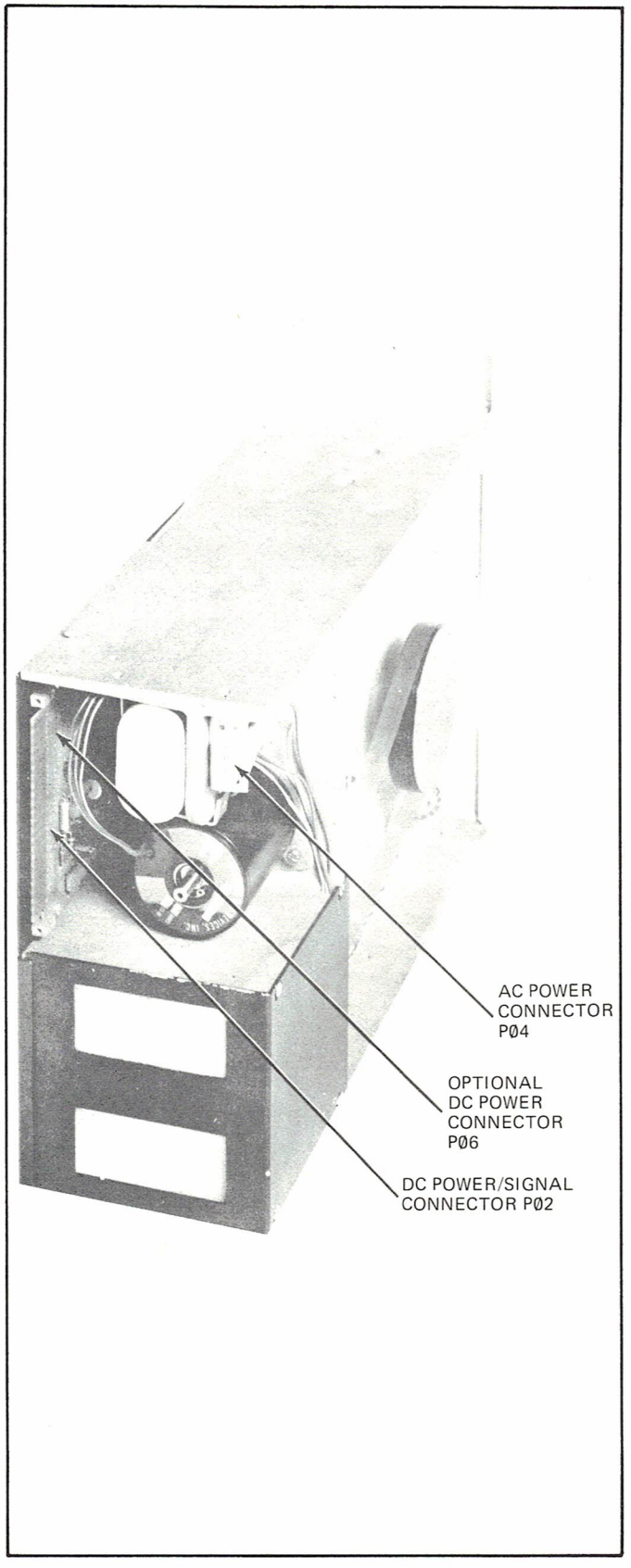

FIGURE 1-4 INTERFACE CONNECTORS

SECTION II
FUNCTIONAL DESCRIPTION

2-1 DISK DRIVE BASIC OPERATION.
(See Figure 2-1)

The Model 210 Drive requires external AC and DC power. The AC power drives the Diskette drive motor and the DC power controls the operation of the electronics and the Track Access Stepping Motor (Head Position Actuator). Following the application of power and the loading of a Diskette the Control Logic generates a READY signal if the DEVICE SELECT signal is set. The Control Logic responding to commands from a suitable external controller positions the Read/Write Head to the desired track, loads the head and sends a TRACK 00 signal, INDEX pulses (and SECTOR pulses Model 220) to the User's system. The WRITE & SAFETY LOGIC causes write head current to flow and record data on the Diskette in response to WRITE DATA pulses from the User's system in conjunction with WRITE GATE and WRITE CURRENT SELECT control signals. It also senses the possible loss of data due to a malfunction and generates the FILE UNSAFE signal which interrupts operation. The User's system may reset this condition by sending a FILE UNSAFE RESET signal to the Drive Electronics. A hardware WRITE PROTECT feature is available. (See Option 2-20). The READ LOGIC senses the output of the read head which consists of the combined clock and data pulses used with the double frequency recording techniques. It separates the pulses and sends SEP CLOCK and SEP DATA pulses to the User's system. Optionally the unseparated data can be provided.

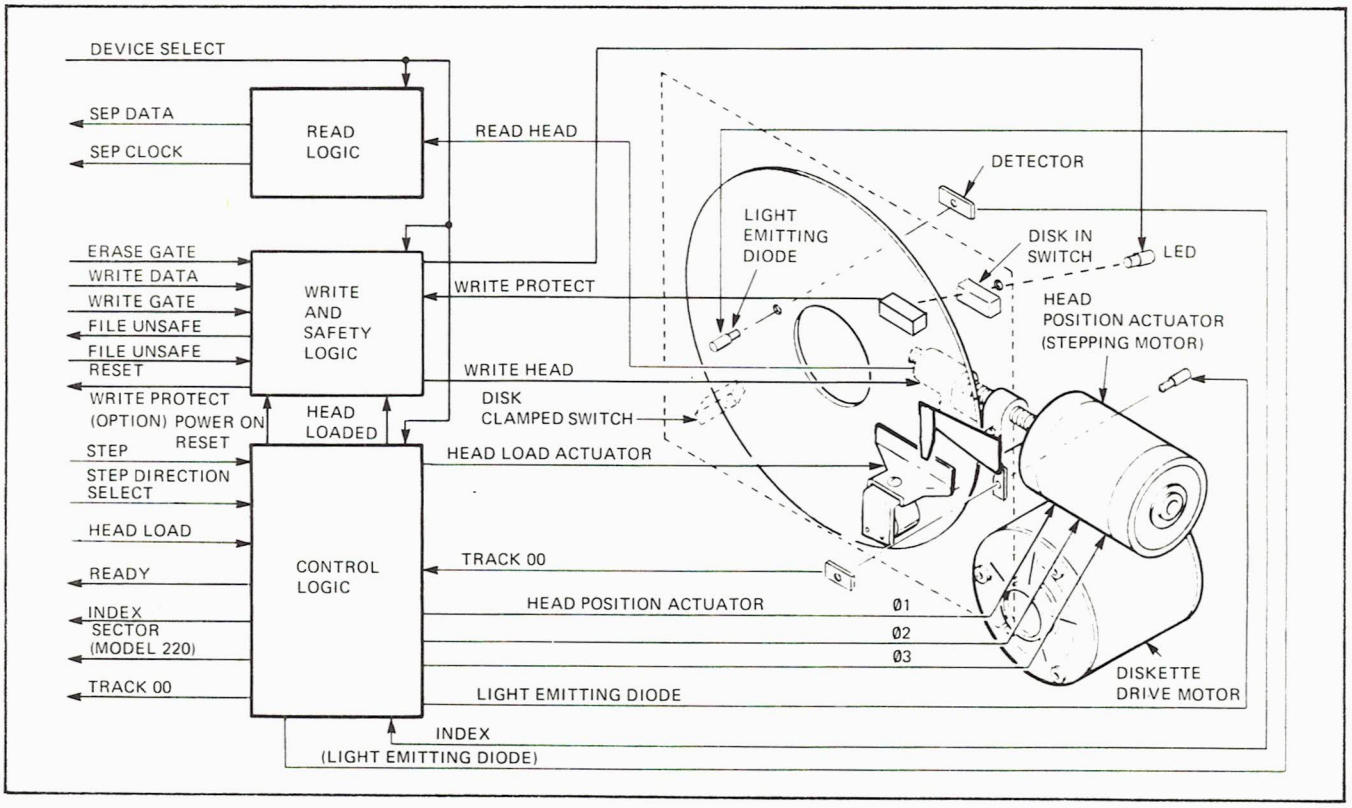

FIGURE 2-1 DISK DRIVE PICTORIAL SCHEMATIC

Positioning of the Read/Write Head over a specific track is accomplished by the Control Logic, a stepping motor and a lead screw on which the head carriage moves. The User's system controls the direction of head movement using the STEP DIRECTION SELECT line to move the head in towards the center of the Diskette (track 76) or out towards the edge of the Diskette (track Ø). STEP pulses are applied to the Control Logic in conjucntion with the STEP DIRECTION SELECT signal to cause the head to "STEP IN" or "STEP OUT". Each pulse causes the stepping motor to rotate the lead screw 15 degrees clockwise or sounter-clockwise. This rotational movement displaces the head exactly one track position.

Prior to a Read or Write operation, the User's system sends a HEAD LOAD signal to the Control Logic. This energizes a solenoid which is part of the Head Load and Carriage Assembly as shown in Figure 2-2. With the solenoid energized, the Lifter drops, which allows the spring loaded Load Arm to press the Load Pad against the floppy Disk. Thus, the Disk is lightly loaded against the rigidly mounted head bringing them in direct contact through the Read/Write Head opening in the Disk plastic envelope. Head to Disk direct contact is maintained by restraining the Disk between the head and the Load Pad with the Load Spring.

The head is a single element read/write head with tunnel erase elements which provide erased areas between data tracks. Thus, normal tolerances between recording media and drives cannot degrade the signal to noise ratio and Diskette interchangeability is assured.

The Diskette drive motor rotates the spindle at 360 rpm (1 revolution every 166.67 milliseconds) using the input AC power at 50 or 60 Hz to control a belt-drive system. Power frequency changes are accommodated for either 50 or 60 Hz by changing the size of the drive pulley. A registration hub, centered on the face of the spindle locates the Diskette in the proper position. The Loading Frame which moves with the front door holds the Diskette to the registration hub.

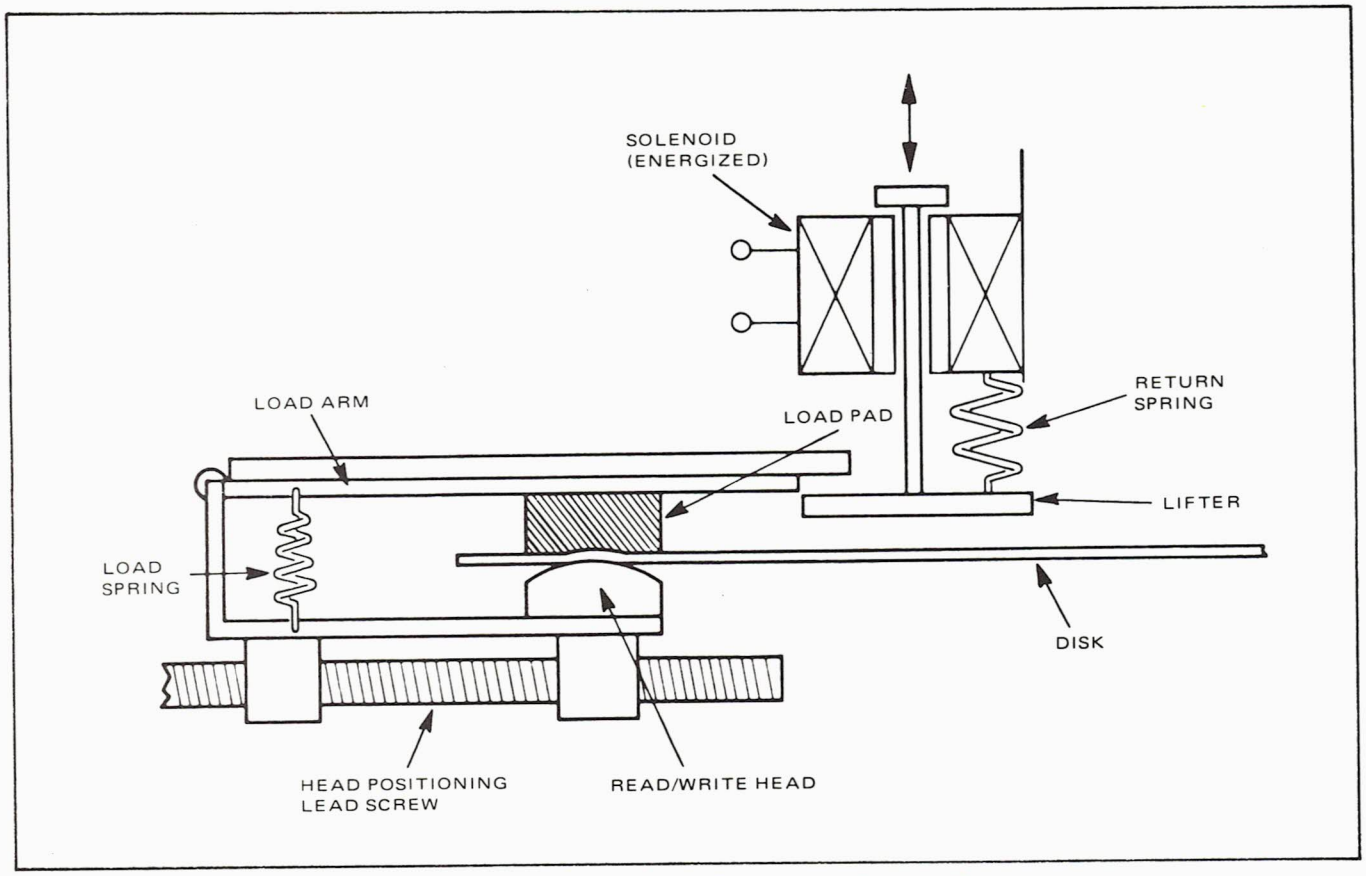

FIGURE 2-2 HEAD LOAD AND CARRIAGE ASSEMBLY

2-2 POWER-ON SEQUENCE.

AC and DC power must be applied for at least 4-seconds prior to initiating a read or write operation. This provides time for the Diskette Drive Motor to reach 360 RPM and to assure accurate track positioning of the Read/Write Head. It is considered good practice to perform a "STEP OUT" operation until Track ØØ is reached to insure proper positioning after an initial power turn-on. The HEAD LOAD signal may be applied any time after the DC power as long as it precedes a read or write operation by at least 30 milliseconds.

2-3 HEAD POSITIONING.

Moving the Read/Write head from one track to another prior to initiating a Read or Write operation is termed "SEEKING". A SEEK is performed when the User's system controls the level of the STEP DIRECTION SELECT interface signal and then pulses the STEP line. Each pulse moves the head one track either in or out depending on the level of the STEP DIRECTION SELECT. If it is positive (2.5 V to 5.5 V), a STEP pulse causes the head to "STEP-OUT" and move one track away from the center of the disk. If STEP DIRECTION SELECT is at ground (0 V to 0.4 V), a STEP pulse moves the head towards the center one track position (STEP-IN).

2-4 WRITE DATA.

Double frequency recording is used to write data. The write data consists of an encoded stream of 200 nanosecond pulses in which clock pulses occur at a 4.00 microsecond rate. The time between adjacent clock pulses is the bit cell time. If a logical 1 is to be written a 200 nanosecond data pulse must be provided at the mid point of this time and no data pulse must occur if a logical Ø is to be stored. During a Read operation, the clock and data pulses are separated and sent to the User's system on two different interface lines. To prevent the unintentional loss of data, safety circuits are incorporated which inhibit writing if a hardware failure occurs or if the drive is interferred with. If an unsafe condition is detected, the FILE UNSAFE signal is sent to the User's system, a latch is set in the drive electronics and writing is inhibited until a FILE UNSAFE RESET pulse is received from the User. FILE UNSAFE is defined as follows:

$$\text{FILE UNSAFE} = \text{HEAD UNLOADED} \cdot \text{WRITE GATE} + \text{WRITE GATE} \cdot \text{WRITE PROTECT}^* + \text{WRITE GATE} \cdot \overline{\text{WRITE DATA}} + \text{WRITE GATE} \cdot \overline{\text{WRITE CURRENT}} + \overline{\text{WRITE GATE}} \cdot \text{WRITE CURRENT}$$

*WRITE PROTECT Option

To select the proper amount of write current, the WRITE CURRENT SELECT interface line must be held low (0 to 0.4 volts) when writing on tracks Ø to 43 and it must be held high (2.5 to 5.25 volts) when writing on tracks 44 to 76.

2-5 READ DATA.

A read operation may be initiated by the LOAD HEAD interface signal when the Read/Write head is positioned over the correct track. As long as the WRITE GATE is not enabled, the read operation commences. At least 30 milliseconds must elapse following the Load Head signal or if the Head is already loaded 20 milliseconds following the last step pulse before reliable data pulses are received from the disk. Reading continues with data pulses and clock pulses being separated and sent to the User's system until the Read/Write head is unloaded.

2-6 INTERFACE SIGNALS.

The Model 210 Drive requires three types of interface signals; power, data and control. Data and control signals are TTL digital pulses or levels using ground asserted logic (i.e. 0 to 0.4 volts is true). Logic level specifications are:

V_{in} = 0 to 0.4 volts = logical Ø = true (low)
V_{in} = 2.5 to 5.5 volts = logical 1 = false (high)
V_{out} = 0 to 0.4 volts = logical Ø = true (low)
V_{out} = Open circuit (transistor in cut-off) = logical 1 = false

2-7 Power Signals. AC input power required is:

95-127 VAC 60 Hz .27 Amps. Nom.
88-127 VAC 50 Hz .31 Amps. Nom.
195-264 VAC 50 Hz .16 Amps. Nom.
50 or 60 Hz ± 0.5 Hz, single phase
DC input power required is:
+5 ± 0.25 VDC @ 800 MA max., 50 mV ripple
−5 ± 0.25 VDC @ 75 MA max., 50 mV ripple
+24 ± 2VDC @ 1.4 A max., 100 mV ripple

2-8 Input Data Signals. Only one input data signal is used. The WRITE DATA signal is a composite clock and data bit signal with each transition from high to low (logical 1 to 0) causing the current through the Read/Write head to reverse and record a flux reversal on the disk.

2-9 Output Data Signals. Two output data signals are used. SEPARATED DATA is the read signal derived from the disk and sent to the User's system. The double frequency signal written on the disk is separated by the drive electronics and the data pulses are sent to the User on this interface line. Normally the line is at a logical 1 and each data bit read from the disk causes a logical Ø transition for 200 nanoseconds.

The second output data signal is SEPARATED CLOCK which provides the User's system with the clock bits recorded on the disk using the double frequency recording scheme. Clock pulses occur every 4 microseconds independent of the data bits.

2-10 Input Control Signals. Seven input control signals are used as follows:

(1) DEVICE SELECT. This signal activates the drive to be used. It must be generated separately for each drive on the bus. A logic Ø enables the Control and Data circuits of the selected drive to communicate with the I/O bus. In a single drive system this line may be permanently connected to ground.

(2) WRITE GATE. This signal controls the writing of data on the disk. A logical 1 level turns-off the current source to the write drivers and the current sinks for the write currents. A logic Ø disables the head positioning circuitry (stepping motor) and enables the write drivers and current sinks.

(3) STEP DIRECTION SELECT. This signal controls the direction of Read/Write Head motion during a Seek when the STEP line is pulsed. An open circuit or logical 1 level is the OUT direction and a STEP pulse under these conditions causes the head to move away from the center of the disk. If DIRECTION SELECT is grounded (logical Ø), the IN direction is selected and the Read/Write Head moves towards the center of the disk with each STEP pulse.

(4) STEP. This line pulses to move the Read/Write Head one track position with each pulse. Direction of head motion (IN or OUT) is determined by the STEP DIRECTION SELECT line described above. Stepping occurs on the trailing edge of each pulse during the logical Ø to logical 1 transition.

(5) HEAD LOAD. This signal controls the solenoid actuator to move the disk into contact with the fixed Read/Write Head. An open circuit or logical 1 de-energizes the solenoid and the head load actuator causes the Lifter to raise the pressure pad from the disk which removes the load from the disk and Read/Write Head. A logical Ø level activates the solenoid which brings the disk into contact with the head in preparation for reading or writing data.

(6) WRITE CURRENT SELECT. This interface line controls the amount of write current flowing through the Read/Write Head as a function of the track position. It must be shorted to ground (logical Ø level) when writing on tracks Ø to 43 and must present an open circuit (logical 1 level) when writing on tracks 44 through 76.

(7) FILE UNSAFE RESET. This control line resets the File Unsafe Latch when a logical Ø pulse (ground) is presented. Normal inactive level for this line is a logical 1 level.

NOTE

The drive must never be operated with this signal line at a constant logical Ø level since the data safety circuitry is defeated during this condition and loss of data is possible.

2-11 Output Control Signals. Six output control signals are used as follows:

(1) READY. A logic Ø on this signal line indicates that the AC and logic power are present, a Diskette is loaded and the drive is selected.

(2) INDEX. This signal is derived from the disk once per revolution (every 166.67 milliseconds). It indicates the beginning of a track. Normally this signal is at a logical 1 level and makes a logical Ø transition to ground for 0.5 milliseconds during eadh revolution.

(3) TRACK ØØ. This signal is at a logical Ø level when the Read/Write head is positioned over the outermost track and the head positioning circuitry is driving current through phase three of the stepping motor. It is at a logical 1 level for all other track positions.

(4) FILE UNSAFE. This is the output of the data safety circuitry and is normally at a logical 1 level. If a condition occurs which makes the file unsafe, it switches to a logical Ø. The Boolean expression for the logical Ø state is as follows:

$$\text{FILE UNSAFE} = \text{HEAD UNLOADED} \cdot \text{WRITE GATE} + \text{WRITE CURRENT} \cdot \overline{\text{WRITE GATE}} + \text{WRITE GATE} \cdot \text{WRITE PROTECT}^* + \text{WRITE GATE} \cdot \overline{\text{WRITE DATA}} + \text{WRITE GATE} \cdot \overline{\text{WRITE CURRENT}}$$

*write protect option

(5) SECTOR (Model 220). Hard sectoring is provided for when a Diskette having 32 equally spaced sector holes plus one index hole is used. The sector pulses consist of logical Ø transitions of 0.5 msec nominal duration at 5.21 msec ±1% intervals.

2-12 References. Figure 2-3 illustrates the power, data, control line interconnections and tables 2-1 through 2-4 list their pertinent characteristics.

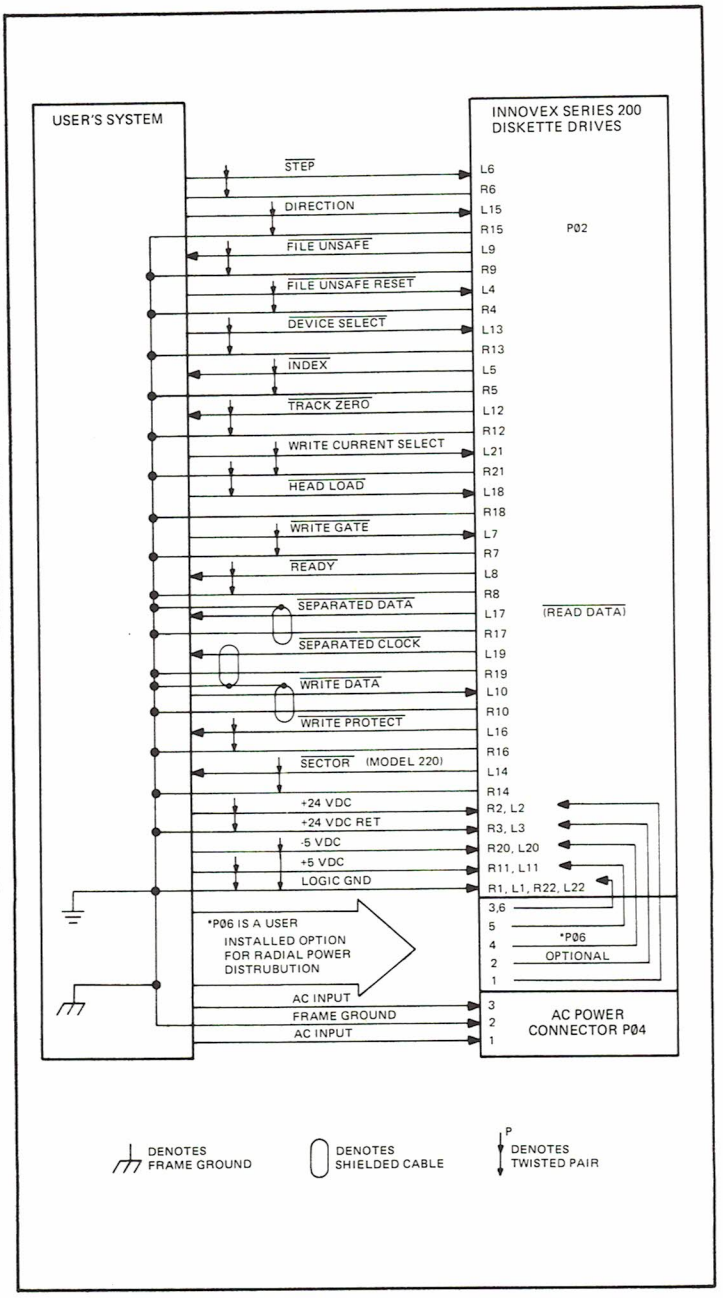

FIGURE 2-3 ELECTRICAL INTERFACE CONNECTIONS

TABLE 2-1 INPUT CONTROL SIGNALS

SIGNAL DESIGNATION	INNOVEX CONNECTOR PIN	P. C. B. FINGER	ACTIVATION POLARITY	PULSE WIDTH	COMMENTS
—Step	JØ2-6	PØ2-L6	Low	10 μ Sec to 500 μ Sec	Track Positioning
Common Return	JØ2-F	PØ2-R6	Ground		
—Direction	JØ2-15	PØ2-L15	High = Reverse = Step Out Low = Forward = Step In	Level	
Common Return	JØ2-S	PØ2-R15	Ground		
—Device Select	JØ2-13	PØ2-L13	Low	Level	Enables I/O Transmitters and Receivers
Return	JØ2-P	PØ2-R13	Ground		
—Load Head	JØ2-18	PØ2-L18	Low	Level	Enables Head Load Solenoid
Common Return	JØ2-V	PØ2-R18	Ground		
File Unsafe Reset	JØ2-4	PØ2-L4	Low	1μ Sec Must Be High During Write	Reset For Control Logic
Common Return	JØ2-D	PØ2-R4	Ground		
—Write Gate	JØ2-7	PØ2-L7	Low	Level	Enabling For Writing Data
Common Return	JØ2-H	PØ-R7	Ground		
Write Current Select	JØ2-21	PØ2-L21	LOW for track 0-43 HIGH FOR 44-76	Level	
Common Return	JØ2-Y	PØ2-R21	Ground		
—Ready	JØ2-8	PØ2-L8	LOW	Level	Drive Ready to Read or Write
Common Return	JØ2-J	PØ2-R8	Ground		

TABLE 2-2 OUTPUT CONTROL SIGNALS

SIGNAL DESINGNATION	INNOVEX CONNECTOR PIN	P. C. B. FINGER	ACTIVATION POLARITY	PULSE WIDTH	COMMENTS
–Index	JØ2-5	PØ2-L5	Low	0.5 ms	Indicates Angular Reference Position On Disc
Common Return	JØ2-E	PØ2-R5	Ground		
–Track ØØ	JØ2-12	PØ-L12	Low	Level	Indicates When Head Is Positioned On Track ØØ
Common Return	JØ2-N	PØ2-R12	Ground		
–File Unsafe	JØ2-9	PØ2-L9	Low	Level	Safety Sensing Signal Indicating File Malfunction
Common Return	JØ2-K	PØ2-R9	Ground		
–Sector	JØ2-14	PØ2-L14	Low	0.5 ms	On Model 220 Series Only
Common Return	JØ2-R	PØ2-R14	Ground		
–Write Protect	JØ2-16	PØ2-L16	Low = Write Protect	Level	Option
Common Return	JØ2-T	PØ2-R16	Ground		

TABLE 2-3 DATA SIGNALS

SIGNAL DESIGNATION	INNOVEX CONNECTOR PIN	P. C. B. FINGER	ACTIVATION POLARITY	PULSE WIDTH	COMMENTS
–Sep Data	JØ2-17	PØ2-L17	Low	0.2 μSec	Output Data
Return	JØ-U	PØ2-R17	Ground		From Disc
–Sep Clock	JØ2-19	PØ2-L19	Low	0.2 μSec	Output Clock
Return	JØ2-W	PØ2-R19	Ground		From Disc
–Write Data	JØ2-10	PØ2-L10	Low	0.25 μSec Min 1 μSec Max	Input Data and Clock Signal to File
Return	JØ2-L	PØ2-R10	Ground		

TABLE 2-4 POWER REQUIREMENTS

POWER DESIGNATION	INNOVEX CONNECTOR PIN	P. C. B. FINGER	ACTIVATION POLARITY	DRIVE CHARACTERISTIC	PULSE WIDTH	COMMENTS
Logic Ground	JØ2 -1, -A, -22, -Z	PØ2 -L1, -R1, -L22, -R22	Logic Ground	Logic Ground	Logic Ground	DC Power supply ground
+5VDC	JØ2 -11, -M	p0 -L11, -R11	Positive	+5 ±0.25VDC @ .8A 50 mv ripple	Power Level	Logic Power Supply
−5VDC	JØ2 -20, -X	PØ2 -L20, -R20	Negative	−5 ± 0.25VDC @ 75 mA 50 mv ripple	Power Level	DC power supply for read/write amplifiers
+24	JØ2 -2, -B	PØ2 -L2, -R2	Positive	+24 ± 2VDC @ 1.4A 100 mv ripple	Power Level	DC power supply for head positioning motor, head load solenoid, and write current
+24VDC Return	JØ2 -3, -C	PØ2 -L3, -R3	DC Power ground	DC Power ground	DC Power ground	+24VDC power ground
110 VAC 50/60 Hz		PØ4 Three terminal socket	Line AC	110 ± 10% VAC @ 0.2A 50/60 ± 0.5 Hz single phase	Line AC	Must be provided from a branch circuit protected at no more than 20 amperes.
Frame Ground		PØ4 Center Pin	Frame ground	Frame ground	Frame ground	Center pin of 3-wire AC socket

2-13 OPTIONS

2-14 POWER OPTION

The PCB has been designed to accept a six circuit, printed circuit board pin header assembly, AMP P/N 1-380999-0, which mates with socket housing AMP P/N 1-48027-0 and socket P/N 60619-1. This optional connector allows the user to distribute DC power in a radial fashion. Both connectors are user installed.

2-15 RADIAL INTERRUPT FEATURE (Ungated Ready)

The Ready signal has the option of being present on the interface at all times, regardless of the state of device select. This feature allows the control unit to detect whenever an operator has removed, or installed a diskette in any drive, without having to pole all the devices on line. This feature requires a separate ready line from each drive to the control unit.

2-16 RADIAL ROTATIONAL SENSING FEATURE (Ungated Index and Sector)

The Sector and Index signals may be optionally presented on the interface independent of device select. This feature allows the user to monitor index and sector at all times so that he may select the drive just prior to the desired sector. This feature can significantly reduce the average latency time. The use of this option requires a separate index and sector line from each drive, to the Control Unit.

2-17 RADIAL HEAD LOAD FEATURE (Ungated Head Load)

The use of this option allows the Head to be loaded independently of drive select. Use of this feature will eliminate the 30 ms. head settling time in disk to disk copy operations. The use of this option requires a separate Head Load line from each drive to the Control Unit.

2-18 NEGATIVE DC SUPPLY VOLTAGE FEATURE

As an alternative to the -5 VDC supply the Series 200 drives can be equipped to accept either -12V or -15 VDC at the customer's request.

Power Requirements
-12V ±0.6V @ 100 MA 50 MV ripple
-15V ±0.75V @ 100 MA 50 MV ripple

2-19 READ DATA OPTION

This option provides the unseparated (or raw) data signal on pin L17 of the interface connector PØ2. (i.e., it replaces the SEPARATED DATA signal). The average pulse frequency is constant to within ±1% but individual pulses may be displaced ±0.5 μsec due to the recording process.

2-20 WRITE PROTECT

An optional hardware write protect feature is available. For a given Diskette, Write Protect is detected by means of a hole punched in the jacket at the coordinates shown in Figure 1-2. A logical "1" on this line indicates that writing is permitted on this Diskette (Write Protect hole covered or absent). A logical "0" indicates that writing is not permitted on this Diskette (write protect hole present).

2-21 INTERLOCK

An optional interlock is available which prevents door closure and drive spindle engagement until the Diskette is fully inserted. This interlock has a manual override button for closing the door with power off or with no Diskette inserted.

2-22 STEPPER POWER DISABLE

The use of the option allows the 24 volts to be removed from the stepper motor whenever the device select line is at a logical "1", allowing the motor to run cooler.

NOTE
All options should be specified at time of order.

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SECTION III
MAINTENANCE AND THEORY

3-1 SCOPE.

This section contains maintenance information for the Model 210 Disk Drive including descriptions and theory of the principles of operation. Where applicable, reference is made to the appropriate System Logic Diagrams located in Section IV of this manual. Maintenance information is presented in the following order:

3-2 MAINTENANCE PHILOSOPHY.

The philosophy reflected in the following procedures consists of on-line diagnosis of a malfunction in the Model 210 Drive followed by off-line repair and checkout. No scheduled, preventive maintenance is required if alignment and adjustments are made within the specified ranges, the Drive is properly installed initially and normal care is used when handling and storing disks and spare parts for the drive.

3-3 TOOLS AND TEST EQUIPMENT.

In addition to common hand tools, the following items are required for maintenance:

(1) INNOVEX Head and Index Alignment Tool (part No. 210-8003).
(2) Customer Engineering (CE) Diskette.
(3) Retaining Ring Pliers.
(4) Pull-type, gram gauge (20 gram range).
(5) Oscilloscope, Tektronix 453 or equivalent.
(6) INNOVEX Stepper Clamp Tool (part No. 210-8018).

3-4 DISK HANDLING.

The following precautions should be observed when handling or storing disks. They should be protected in the same manner as computer-type magnetic tape.

- Keep disk in its storage envelope whenever it is removed from the file until it is inserted into the drive.
- Do not touch or attempt to clean disk surface. Abrasions may cause loss of data.
- Avoid exposure to strong sunlight or excessive heat to prevent warping of the disk.
- Write on the plastic jacket with a soft, felt-type pen. Do not use sharp, pointed pencils or ball point pens.
- Strong magnetic fields can distort or destroy recorded data; therefore disks must be kept away from magnetic fields and ferromagnetic materials which may become magnetized.
- Do not smoke while handling disks. Heat and contamination from a carelessly dropped cigarette ash can damage the disk.

3-5 MAJOR ASSEMBLIES.

Figures 3-1 and 3-2 locate the major assemblies of the Model 210 Drive described in the following maintenance procedures.

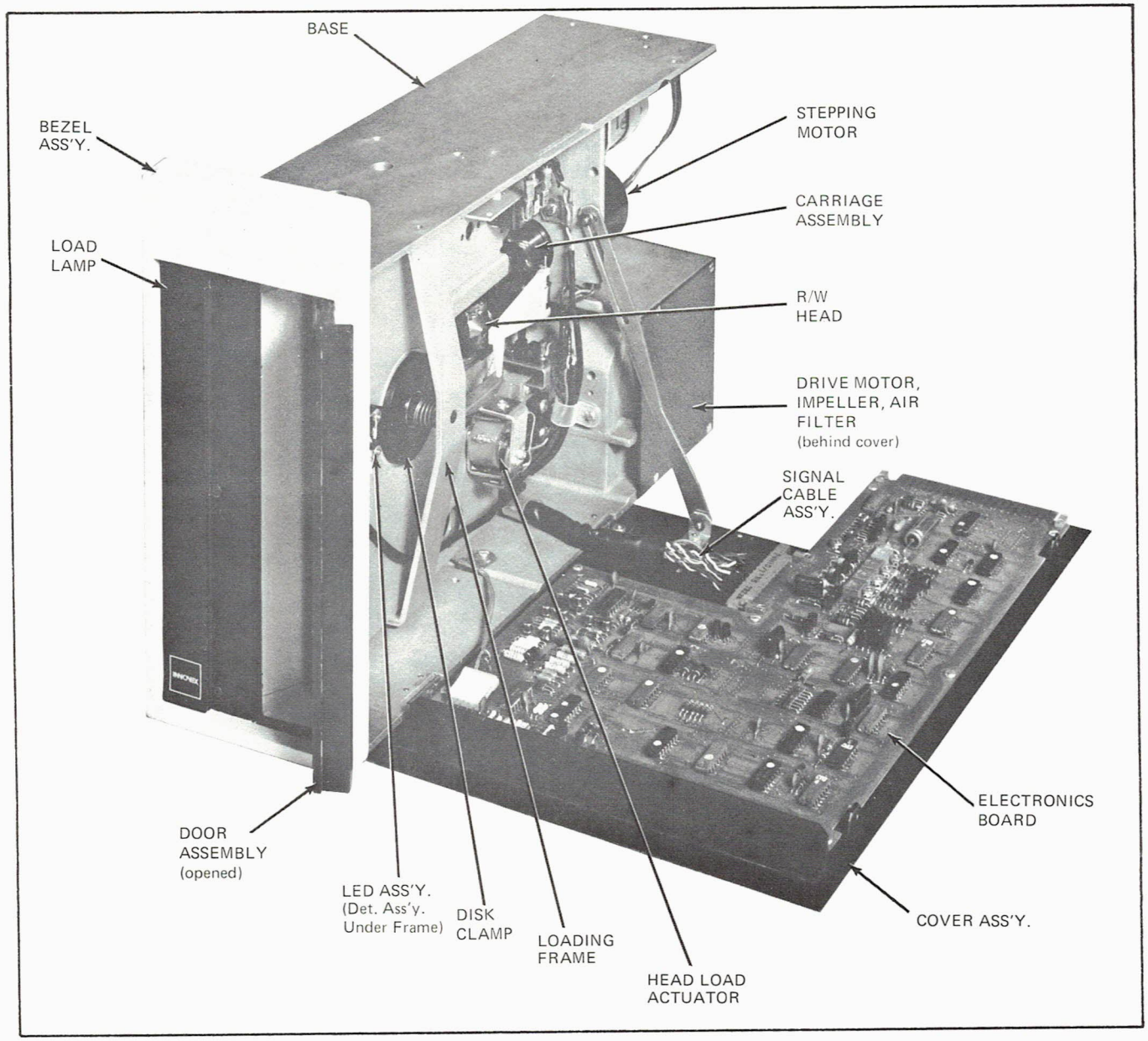


FIGURE 3-1 MAJOR ASSEMBLIES (Sheet 1 of 3)

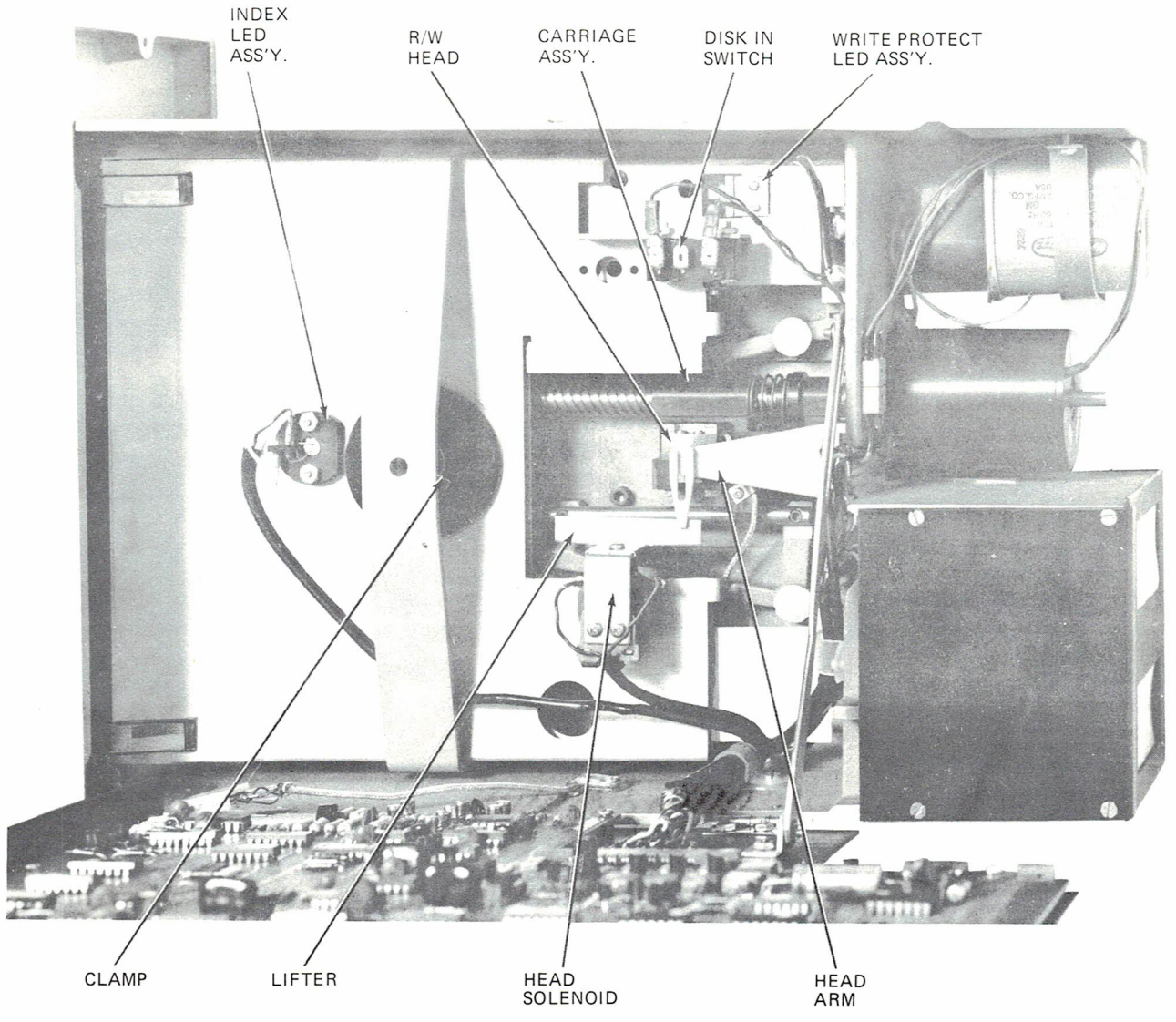


FIGURE 3-1 MAJOR ASSEMBLIES (Sheet 2 of 3)

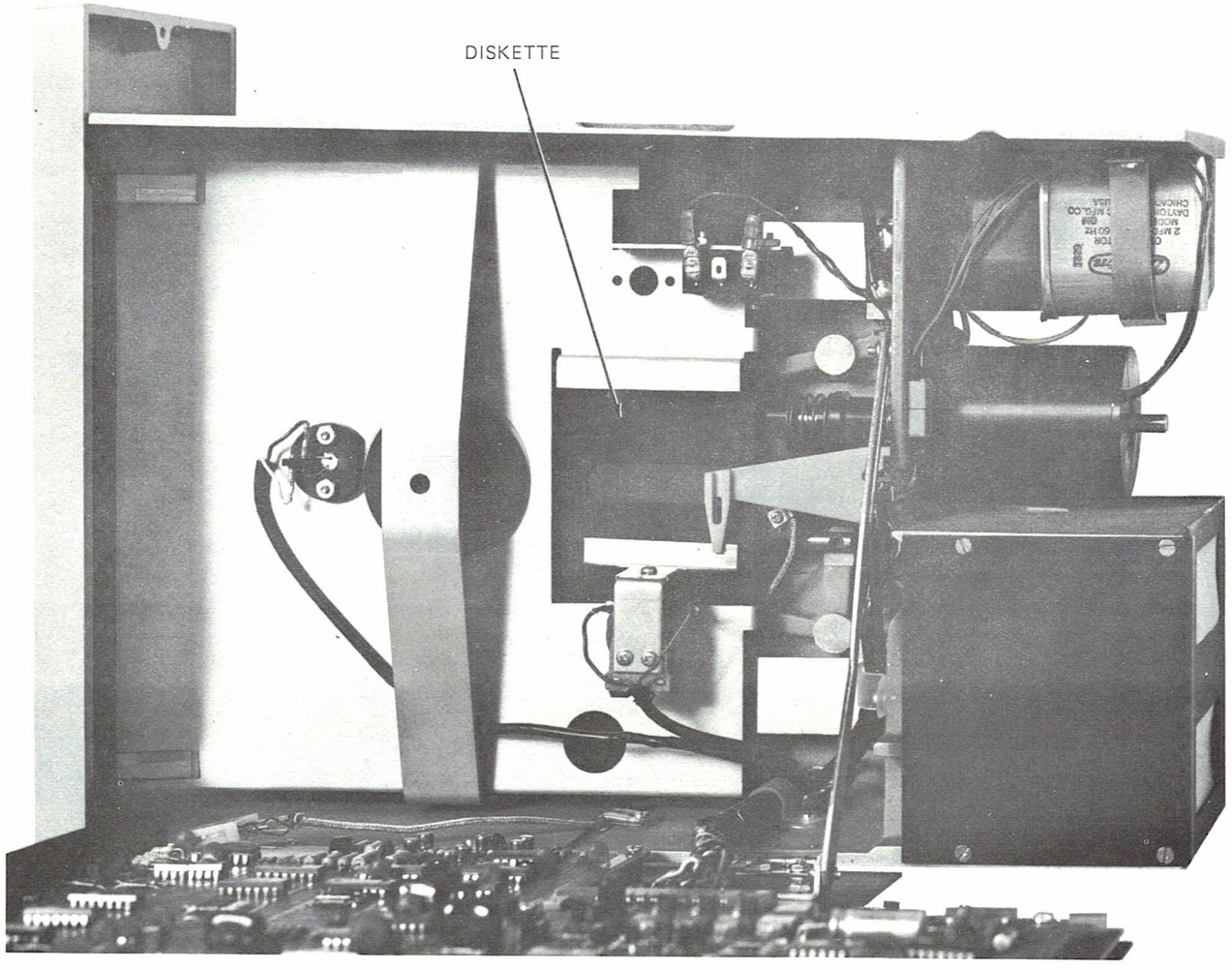


FIGURE 3-1 MAJOR ASSEMBLIES (Sheet 3 of 3)

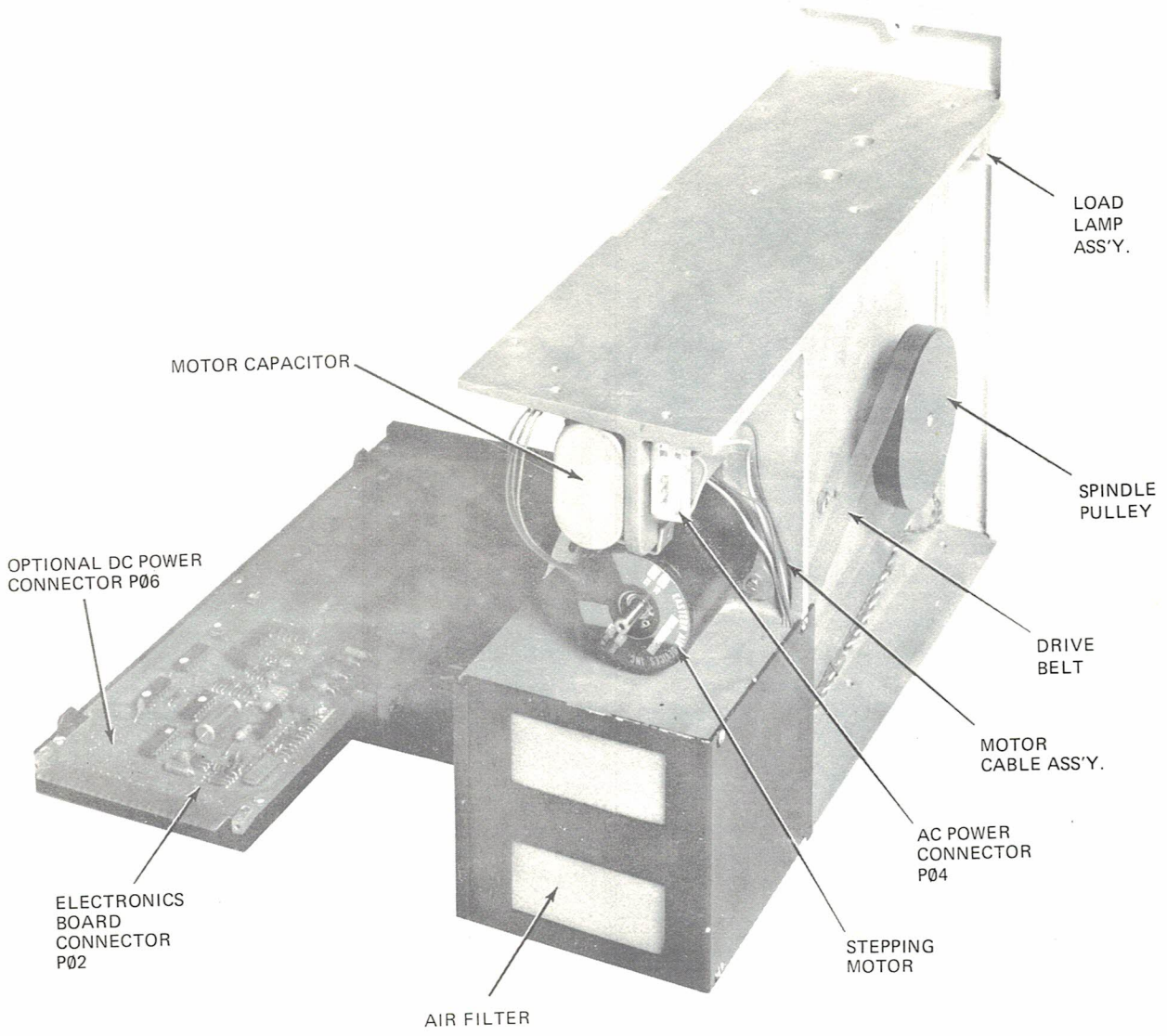


FIGURE 3-2 MAJOR ASSEMBLIES (Rear View)

3-6 ELECTRONIC PC BOARD.

Figure 3-3 illustrates the pc board and locates the test points provided for ease of troubleshooting. Reference is made to these test points throughout the maintenance procedures. Table 3-1 lists the signal name/function at each test point. Refer to the System Logic Diagrams in Section IV for test point circuit locations. The pc board is mounted on the lid of the Model 210 Drive enclosure. It is secured to the lid with 8 screws. To remove the pc board, disconnect R/W head connector, remove 8 attaching screws, disconnect connectors JØ1, JØ2 and JØ6 and remove the pc board. To install the pc board, reverse these procedures.

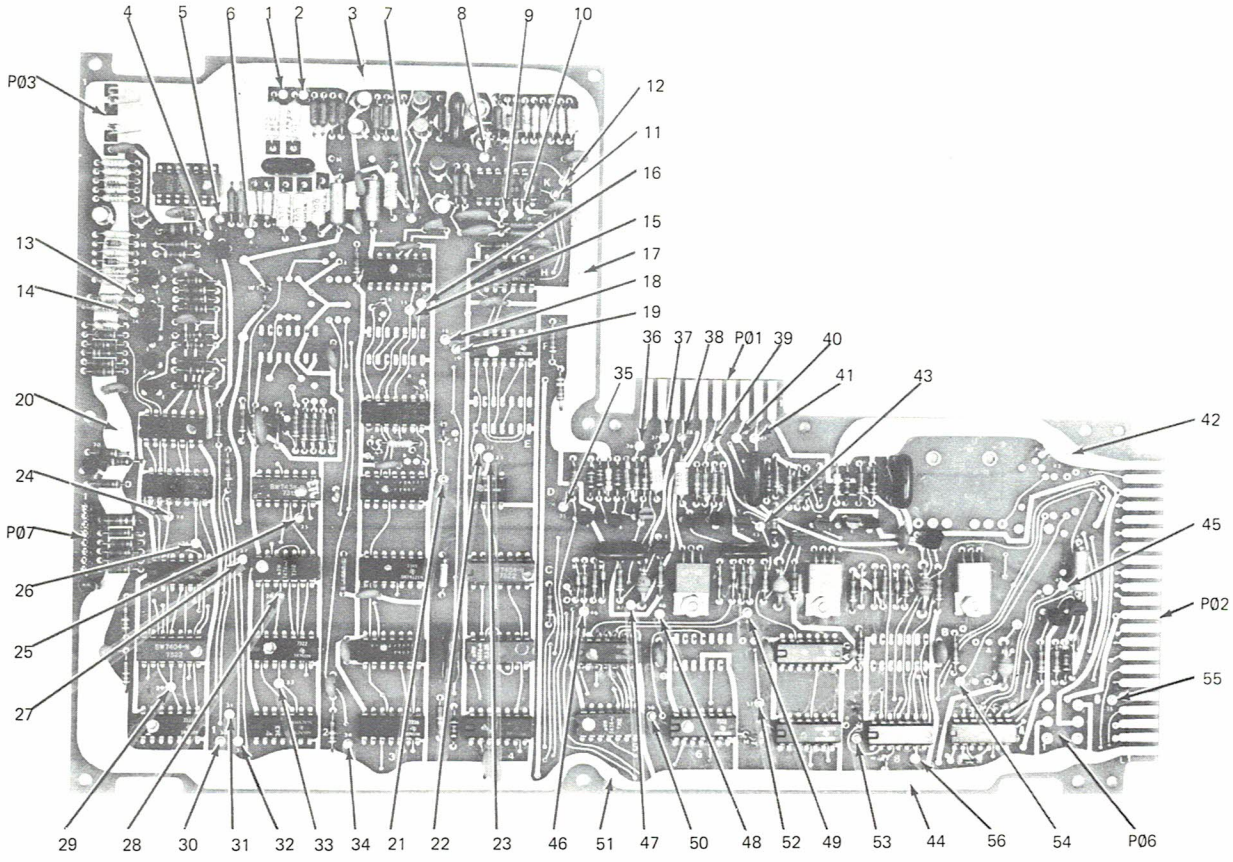


FIGURE 3-3 ELECTRONIC PC BOARD TEST POINTS AND CONNECTORS

TABLE 3-1 PC BOARD TEST POINTS

TEST POINT NO.	FUNCTION	TEST POINT NO.	FUNCTION
1	Filtered Read Data	31	HEAD UNLOADED ($\overline{\text{HDLD}}$)
2	Filtered Read Data	32	FILE UNSAFE
3	Logic Ground	33	$\overline{\text{ERASE GATE}} \cdot \overline{\text{WRITE GATE}} +$ $\overline{\text{ERASE GATE}} \cdot$ WRITE GATE $\cdot$ DELAYED
4	Erase Current Amplifier		
5	Amplified Read Data		
6	Amplified Read Data	34	SET FILE UNSAFE
7	+5 Volts (filtered)	35	TRK Ø AMPLIFIER
8	−5 Volts (filtered)	36	TRK Ø LED +
9	Differentiated Read Data	37	TRK Ø Detector −
10	Differentiated Read Data	38	INDEX/SECTOR DETECTOR −
11	Squared Read Signal	39	INDEX/SECTOR LED +
12	Squared Read Signal	40	WRITE PROTECT LED +
13	Write Current	41	WRITE PROTECT DETECTOR −
14	Write Current	42	Logic Ground
15	Digitized Read Data (+ve peaks)	43	INDEX/SECTOR PULSE AMPLIFIER
16	Digitized Read Data (−ve peaks)	44	Logic Ground
17	Logic Ground	45	$\overline{\text{SECTOR PULSES}}$
18	Spare	46	MOT Ø 1
19	Spare	47	(MOT COM)
20	Logic Ground	48	MOT Ø2
21	Data Separator	49	MOT Ø3
22	SEPARATED DATA	50	$\overline{\text{STEP}}$ + (WRITE GATE + ERASE GATE)
23	SEPARATED CLOCK		
24	$\overline{\text{WRITE GATE + ERASE GATE}}$	51	Logic Ground
25	$\overline{\text{TRK Ø}}$	52	READY
26	$\overline{\text{Write Data Latch}}$	53	WRITE PROTECT
27	ERASE GATE	54	$\overline{\text{Spare}}$
28	Write Gate/Erase Gate Delay One Shot	55	$\overline{\text{INDEX PLS}}$
29	WRITE GATE	56	INDEX SEPARATOR
30	WRITE DATA One Shot		

The basic functions of the pc board are illustrated in the block diagram shown below in Figure 3-4.

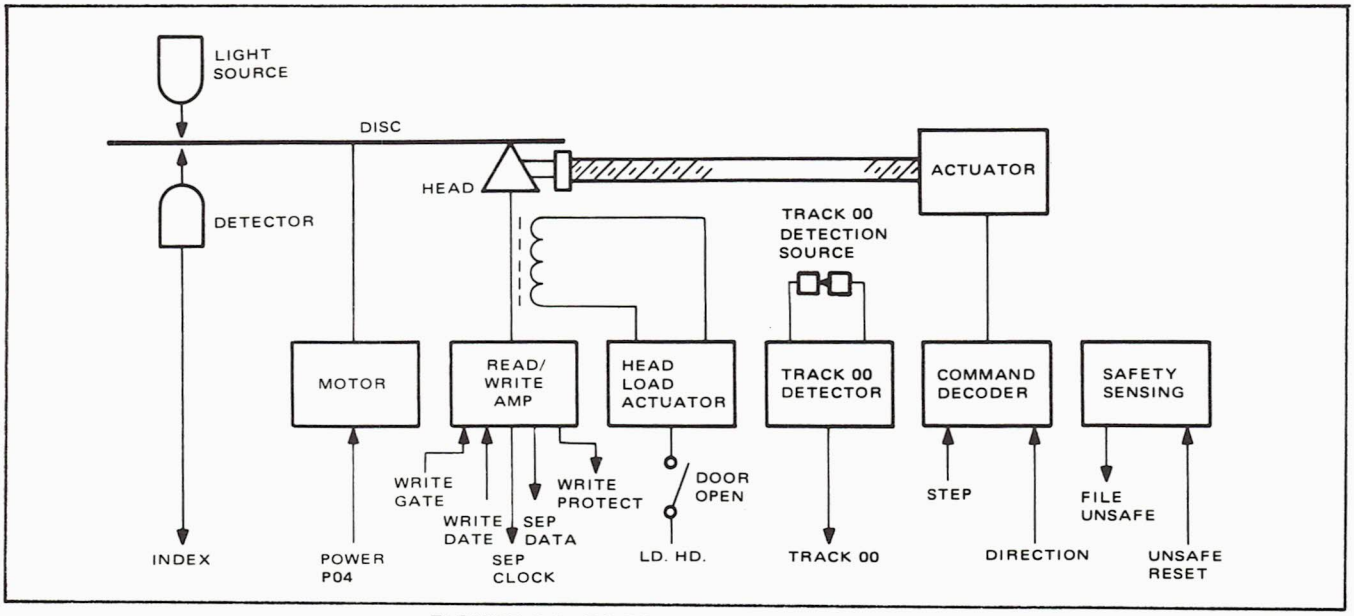


FIGURE 3-4 PC BOARD BLOCK DIAGRAM

3-7 POWER-ON SEQUENCE.

The power-on sequence is initiated by the User's system. In addition, the sequence of events typically are as shown in Figure 3-5 and are also controlled by the User. After at least a 10 millisecond delay, the User pulses the STEP interface line until the R/W head is positioned over track ØØ. The head may or may not be loaded against the disk during this time. After track ØØ is reached, READ or WRITE operations may be initiated. If data from a different track is desired, a series of STEP pulses with the DIRECTION level set for IN must be issued until the desired track is reached.

3-8 READ CIRCUITS.

The read logic circuitry is shown on drawing C210-1263 located in Section IV at the end of this manual. These circuits amplify, filter, differentiate, limit, detect and generate standard 200 nanosecond clock and data pulses derived from the disk. These pulses are then separated and fed to line drivers which send –SEP DATA and –SEP CLOCK pulses to the User's system. The timing relationships are shown in Figure 3-6.

3-9 Read Errors. Most errors that occur are "soft" errors as opposed to hard errors. By performing an error recovery procedure, the data lost from a "soft" error may be recovered.

Soft errors are usually caused by:

(1) Contaminants that pass between the read/write head and the disk. These contaminants are generally removed by the plastic jacket self-cleaning wiper and the air filter.

(2) Random electrical noise which usually lasts for only a few microseconds.

(3) Minor defects in the written data and/or track not detected during the write operation which may cause a soft error during a read operation.

The following procedures are recommended to recover from most soft errors:

(1) Reread the track three times or until such time as the data is recovered.

(2) Step the head one track in the same direction as last moved, then step back to the desired track.

(3) Repeat Step (1).

(4) If data is not recovered, a hard error exists and reference should be made to the Read Circuit Diagnostic Flow Chart shown in Figure 3-7.

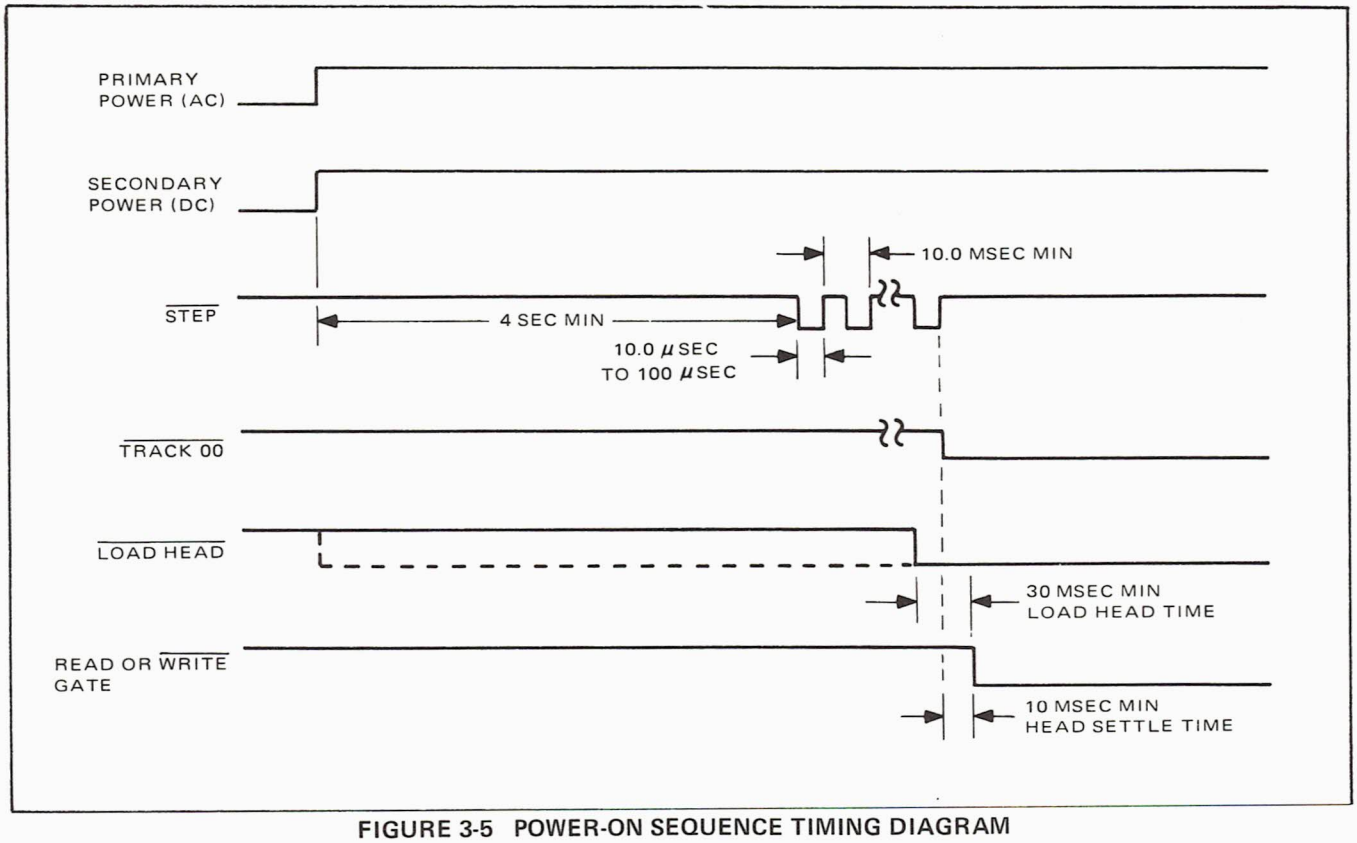
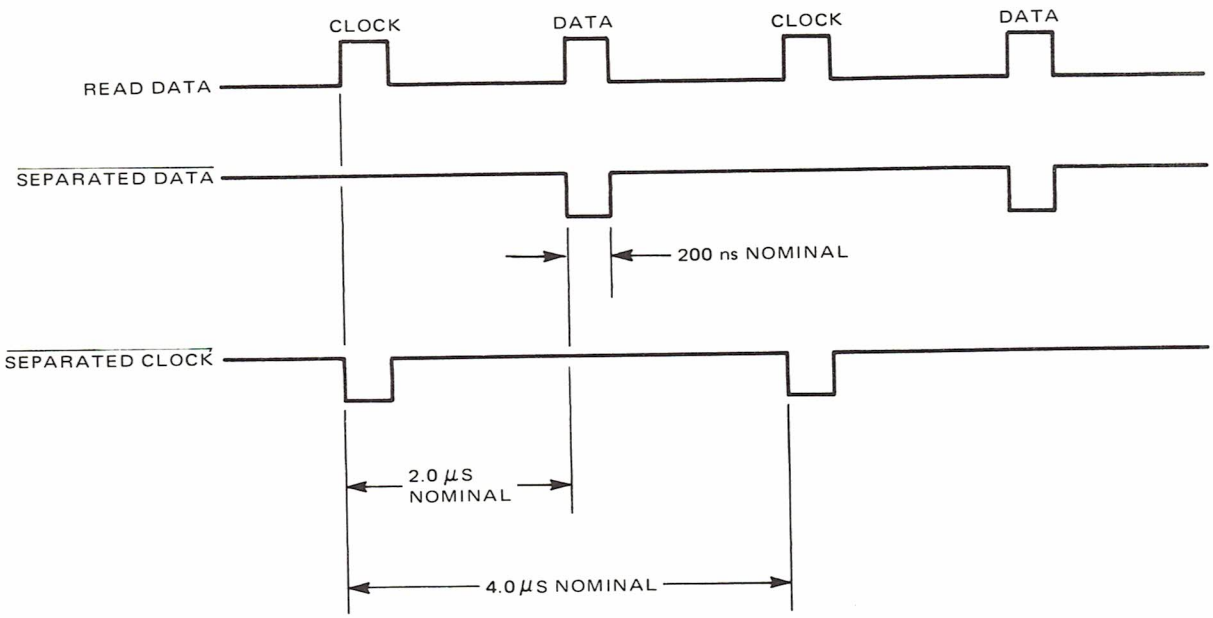
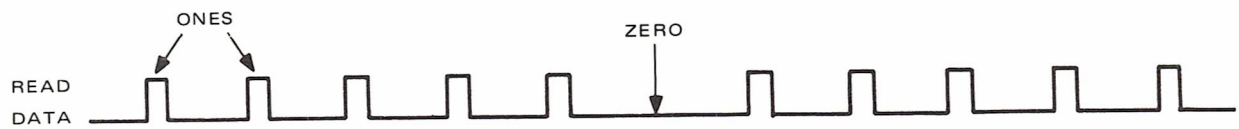


FIGURE 3-5 POWER-ON SEQUENCE TIMING DIAGRAM





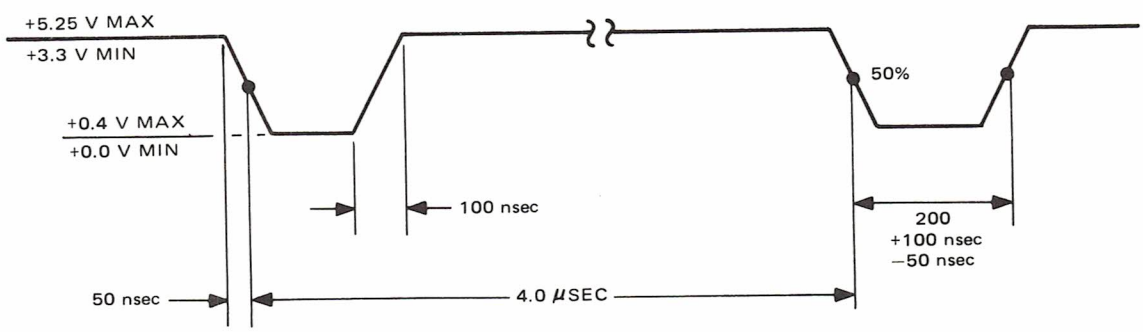


FIGURE 3-6 READ TIMING DIAGRAM

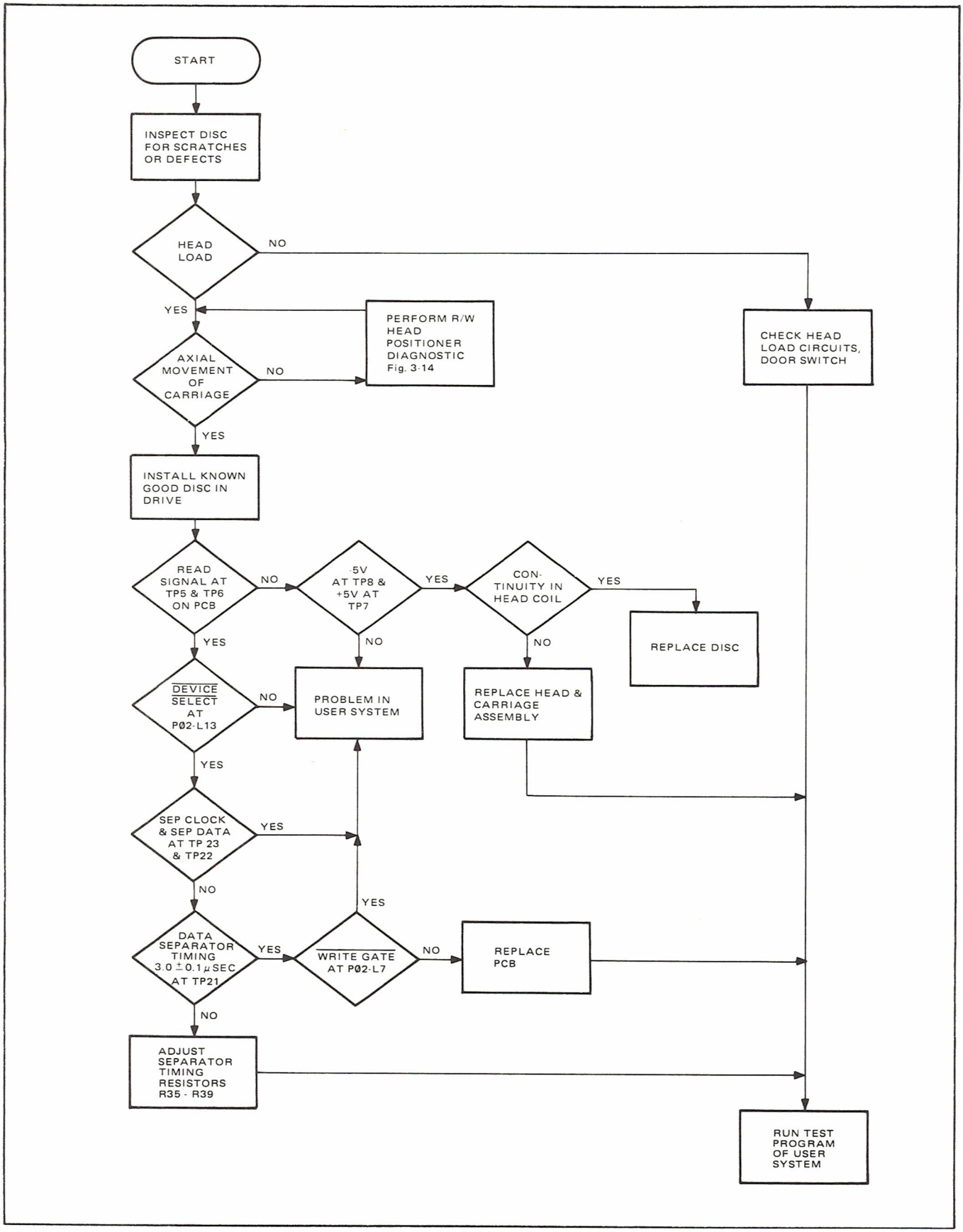
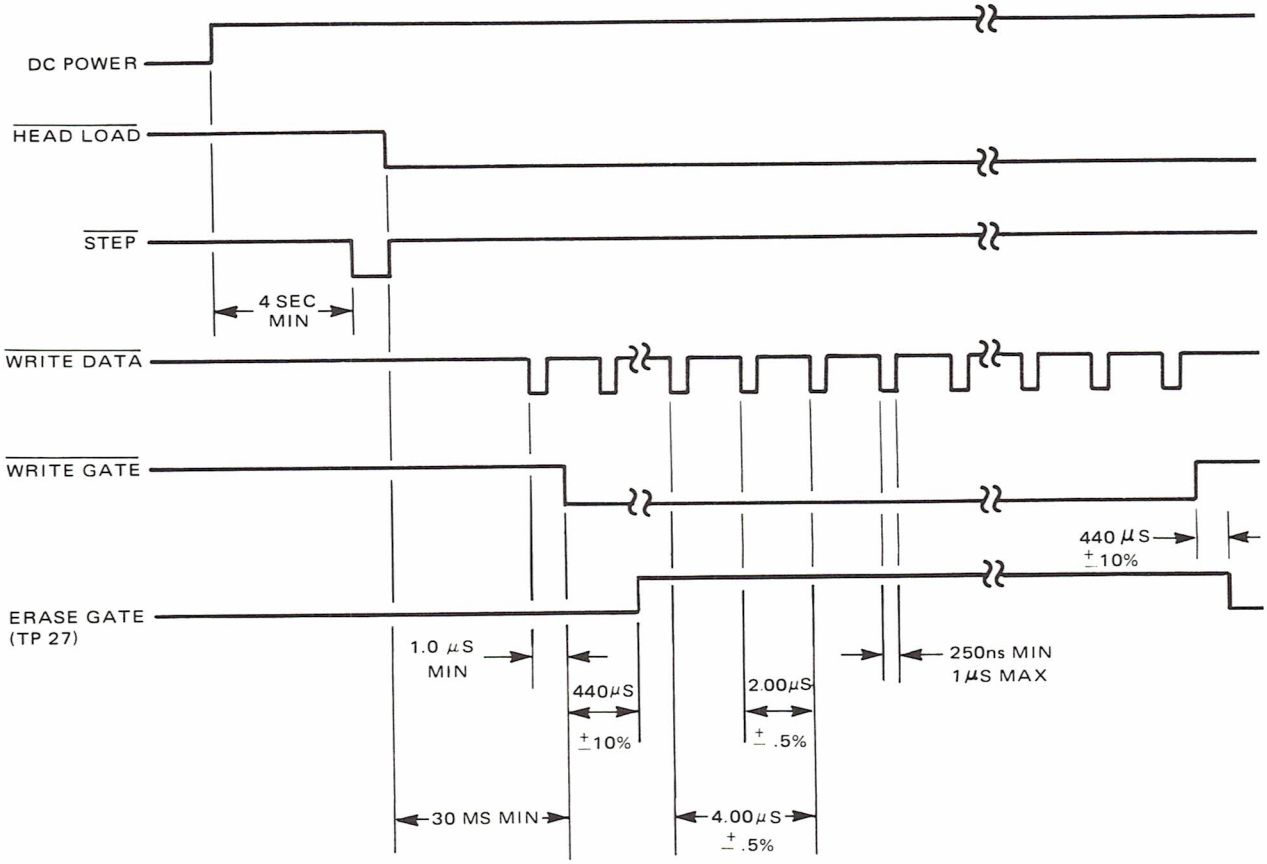


FIGURE 3-7 READ CIRCUIT DIAGNOSTIC FLOW CHART



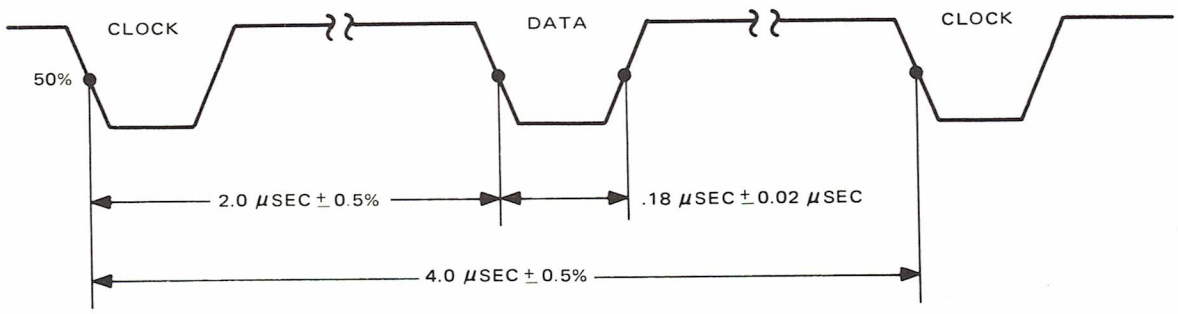


FIGURE 3-8 WRITE TIMING DIAGRAM

3-10 WRITE CIRCUITS

The write logic circuitry is shown on drawing D210-2301-2 located in Section IV. Generally, a SEEK operation is performed prior to the WRITE operation until the R/W Head is positioned over the desired track. Following the SEEK, data is written as shown in Figure 3-8. Data may be written in multiple records per track or single record (index) per track format. Sample format timing is shown in Figure 3-9.

Write errors may be detected by a write check which consists of a read operation performed on the ensuing revolution. Make error correction by repeating write and write check operations. After 3 unsuccessful attempts, perform operation on a different track. If error persists, replace disk, repeat procedure and if error persists, refer to Write Circuit Diagnostic Flow Chart in Figure 3-10.

Recording on the hard sectored diskettes (Model 220) is accomplished by utilizing the 32 sector pulses generated per revolution of the recording media. It is possible to use the 32 sector pulses or to convert them in the external controller to defined subsets of 32, i.e., 16, 8, 4, 2.

However, recording on hard sectored diskettes also requires guard areas at the beginning and end of each sector to accommodate mechanical tolerances and diskette speed variations. The guard areas should be written with all "1"s or all "0"s and extend for a minimum of 462 μ sec plus required clock sync. pulses (Formatter controlled) at the beginning of the sector and a minimum of 462 μ sec plus 1 percent of the nominal sector duration at the end of the sector. The nominal sector duration (T) is determined by dividing the rotational time 166.7 msec by the number of sectors chosen.

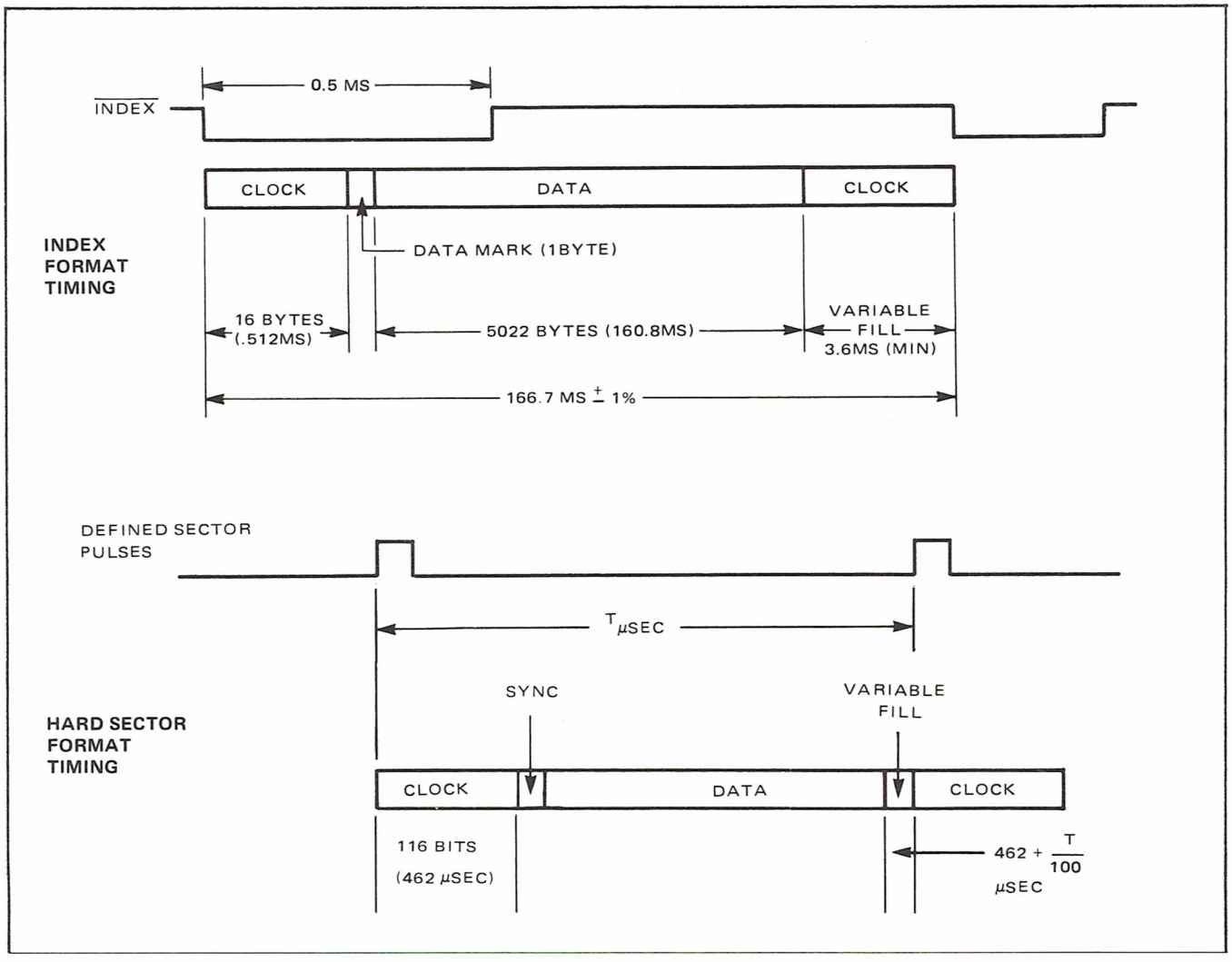


FIGURE 3-9 FORMAT TIMING

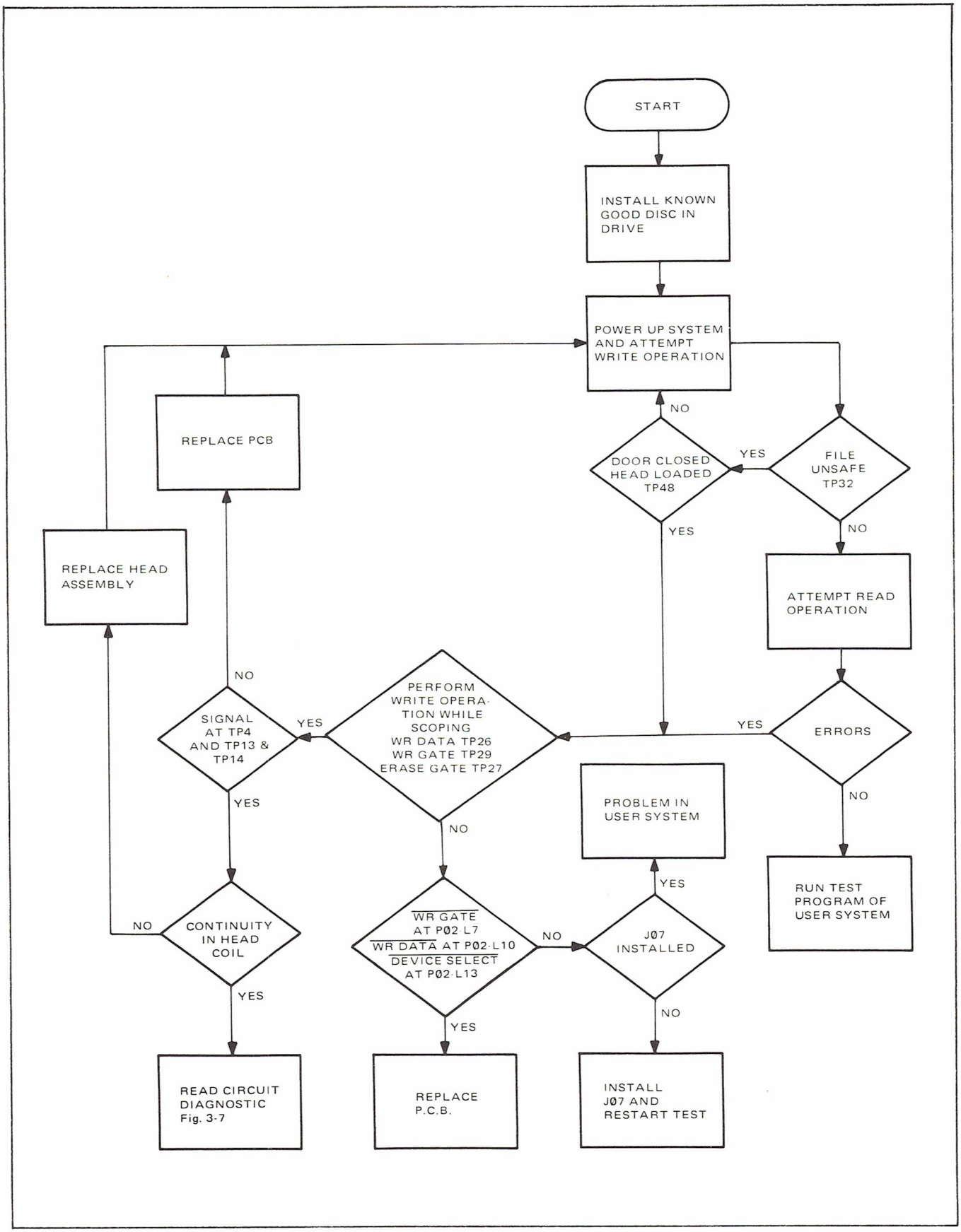


FIGURE 3-10 WRITE CIRCUIT DIAGNOSTIC FLOW CHART

3-11 LOADING FRAME (Refer to Figure 3-11).

The loading frame holds the disk and jacket during normal operation. When the jacket is fully inserted and the access door is closed, the disk is properly positioned between the clamp assembly and the hub. This ensures correct track accessing and normal rotation when the drive motor operates. The loading frame is mounted on shoulder screws that insure accurate positioning when the door is closed. The loading frame may be unclamped quickly to facilitate access to other components.

3-12 Removal.

(1) Open cover after releasing two latching screws.
(2) Remove terminals from L.E.D., head arm solenoid Disk-in switch & Write Protect LED Ass'y.
(3) Remove frame clamps.
(4) Remove Bezel by opening door and removing three screws.
(5) Remove frame lifting springs.
(6) Remove latching levers by pushing frame out front.

3-13 Installation.

(1) Install latching levers.
(2) Place loading frame in position.
(3) Install clamps and shoulder screws making sure the shoulder screw journals are through the loading frame.
(4) Install frame lifting springs.
(5) Install terminals to L.E.D., head arm solenoid and Disk-in switch.
(6) Close cover and latch with two screws.

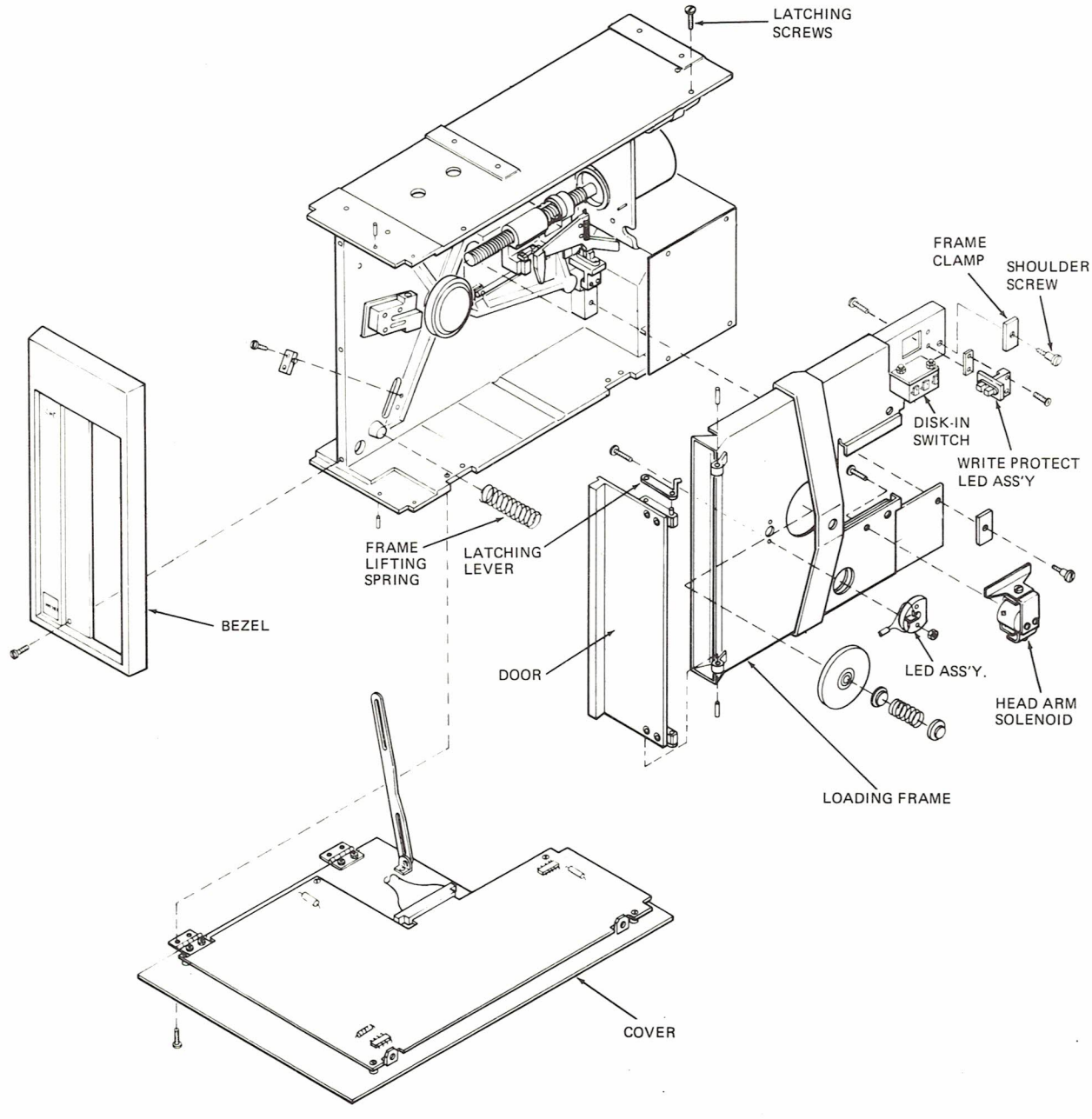


FIGURE 3-11 LOADING FRAME

3-14 CLAMP ASSEMBLY (Refer to Figure 3-12).

The clamp assembly comprises a spring-loaded, ball bearing rotary clamp that presses the disk against the drive hub. The friction created between the hub and disk causes the disk to spin when the hub spins.

3-15 Removal.

(1) Open cover.
(2) Open door.
(3) Remove clamp spring.
(4) Remove clamp assembly.

3-16 Installation.

(1) Open cover.
(2) Position clamp assembly in loading frame.
(3) Install clamp spring.
(4) Close cover.

3-17 HUB AND SPINDLE ASSEMBLY. (Refer to Figure 3-12)

The hub and spindle mount in ball bearings through the baseplate access hole. The spindle pulley is installed outside the baseplate on the spindle. This assembly is then driven by the drive motor and belt to spin the disk inside the loading frame.

3-18 Removal.

(1) Remove filter cover.
(2) Remove belt from spindle pulley.
(3) Remove loading frame per paragraph 3-12.
(4) Loosen set screw in spindle pulley.
(5) Remove pulley.
(6) Remove hub, spindle & load spring.
(7) Remove ball bearings from baseplate.

3-19 Installation.

(1) Install ball bearings in baseplate spindle hole.
(2) Install hub spindle in ball bearings.
(3) Install load spring.
(4) Position spindle pulley on spindle.
(5) Compress load spring to 0.015" height and tighten pulley set screw.
(6) Install loading frame.
(7) Install belt.
(8) Replace filter cover.

3-20 ACCESS DOOR ASSEMBLY. (Refer to Figure 3-12)

The door assembly is connected to the loading frame and baseplate with levers. Closing the door seats the loading frame and actuates the Door Closed switch. The door must be closed securely for operation of the Model 210 Drive.

3-21 Removal.

(1) Remove screws securing door to door levers.
(2) Remove door.

3-22 Installation.

(1) Position door over door levers.
(2) Secure door to latches with screws removed in step 3-21 (1), above.

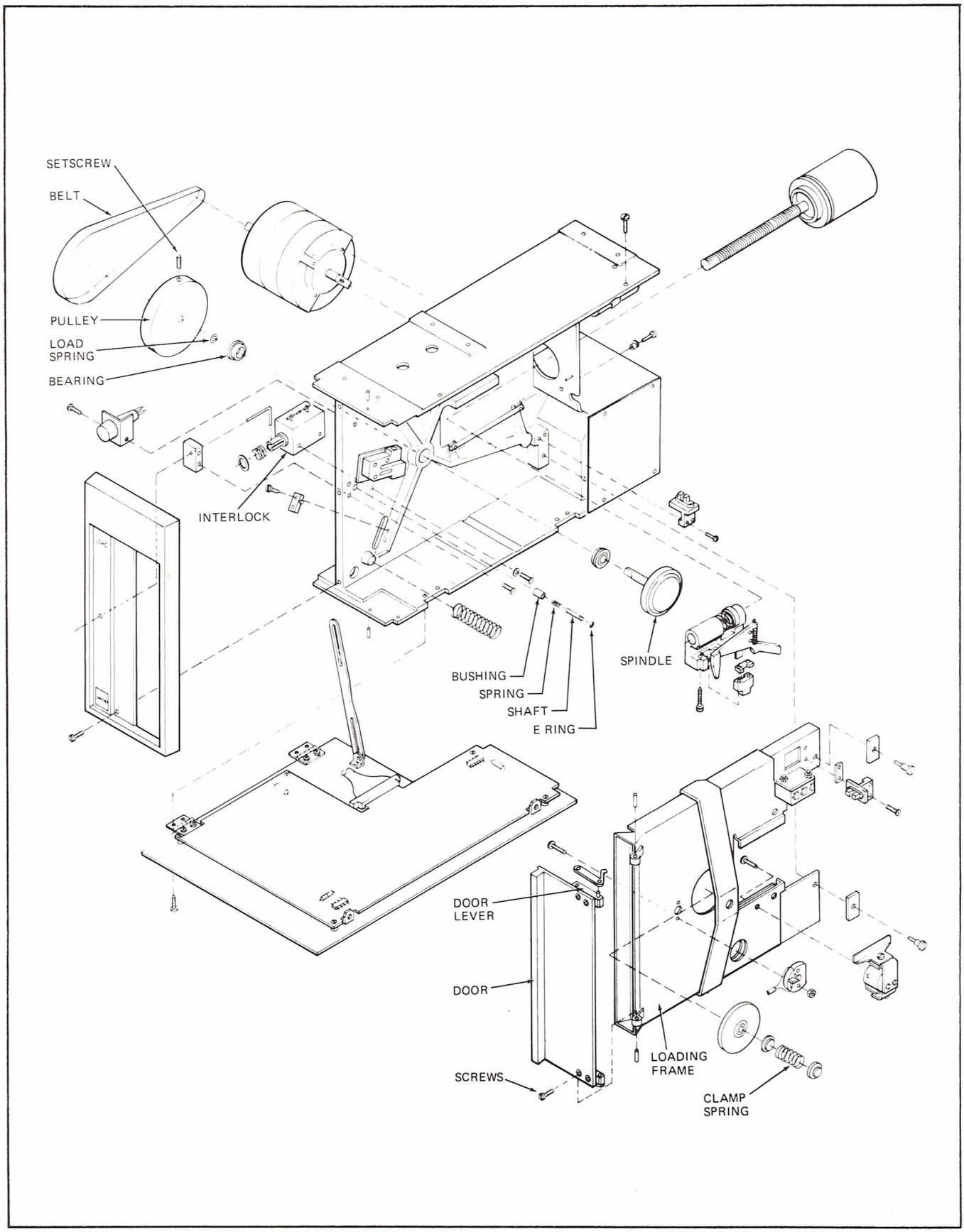


FIGURE 3-12 CLAMP–HUB and SPINDLE–ACCESS DOOR ASSEMBLY–INTERLOCK

3-23 HEAD LOAD ACTUATOR ASSEMBLY (See Figure 3-13).

This assembly uses a solenoid with an extended armature to operate a lifter. When the solenoid is de-energized, the spring-loaded armature moves the lifter such that the spring-loaded headload arm removes pressure from the disk. When the solenoid is energized by the –LOAD HEAD interface signal, the armature moves the lifter towards the disk. This disengages the lifter from the load arm tab and the load arm spring holds the pressure pad against the disk. This places the R/W head in direct contact with the disk. An adjustment is provided to insure that the lifter is not in contact with the load arm tab when the solenoid is energized and still provides the required load arm travel when de-energized. In addition, the load arm spring must supply 15 to 17 grams pressure between the load arm pad and the R/W head when the solenoid is energized.

3-24 Load Arm Force.

(1) Energize solenoid either by activating –LOAD HEAD signal from User's equipment or by grounding test point TP31 on pc board (See Figure 3-3).
(2) Open Cover.
(3) Connect gram gauge to load arm.
(4) Carefully pull gauge until load arm pressure pad releases contact with R/W head.
(5) Gauge should indicate 15 to 17 grams. If not, replace load spring and ensure that there is axialclearance between the load arm and retaining ring.
(6) Close cover.

3-25 Lifter Check Procedure.

(1) Load R/W head per step 3-24 (1) above.
(2) Position R/W head over track ØØ.
(3) Using a feeler gauge, verify that the distance between the lifter and load arm tab is .020 ± .005.
(4) Unload R/W head and verify that lifter moves load arm such that pressure pad does not touch the disk.
(5) Check Head Load Time by scoping Read signal (TP5 and 6) when Head Load command is given. Trigger scope on –VE edge of TP31
(6) Load R/W head, access track 38 and repeat steps (3) and (4).
(7) Load R/W head, access track 76 and repeat steps (3) and (4).
(8) If results obtained in steps (3) and (4) are unsatisfactory on any of the three tracks accessed, perform lifter adjustmant procedure in paragraph 3-26.

3-26 Lifter Adjustment.

(1) Load R/W head.
(2) Loosen lifter adjustment screw.
(3) Adjust lifter position as necessary to meet requirements of steps (3) and (4) of paragraph 3-25.
(4) Tighten lifter adjustment screw.
(5) Perform Head Load Time check procedure (Section 3-27).
(6) Repeat paragraph 3-25 checks.

CAUTION

Use care to prevent lifter or fingers from contacting R/W head during the following removal and installation procedures.

3-27 Head Load Time Check Procedure

(1) Apply AC and DC power to drive.
(2) Insert pre-recorded diskette.
(3) Scope TP5 and TP6 differentially, triggering scope on negative edge at TP31. Set time base to 5 msec./division.
(4) Activate –Head Load signal and observe settling time of Read signal (TP5 and TP6).
(5) Check that the Read signal is settled to less than 10% amplitude modulation after 30 msec.

3-28 Actuator Assembly Removal.

(1) Disconnect actuator electrical leads from solenoid terminals.
(2) Remove actuator mounting screw from rear of loading frame. Use access hole provided in base plate.
(3) Remove actuator assembly.

3-29 Actuator Assembly Installation.

(1) Position actuator assembly on loading frame and secure with mounting screw.
(2) Connect actuator electrical leads.
(3) Perform lifter check procedure per paragraph 3-25.

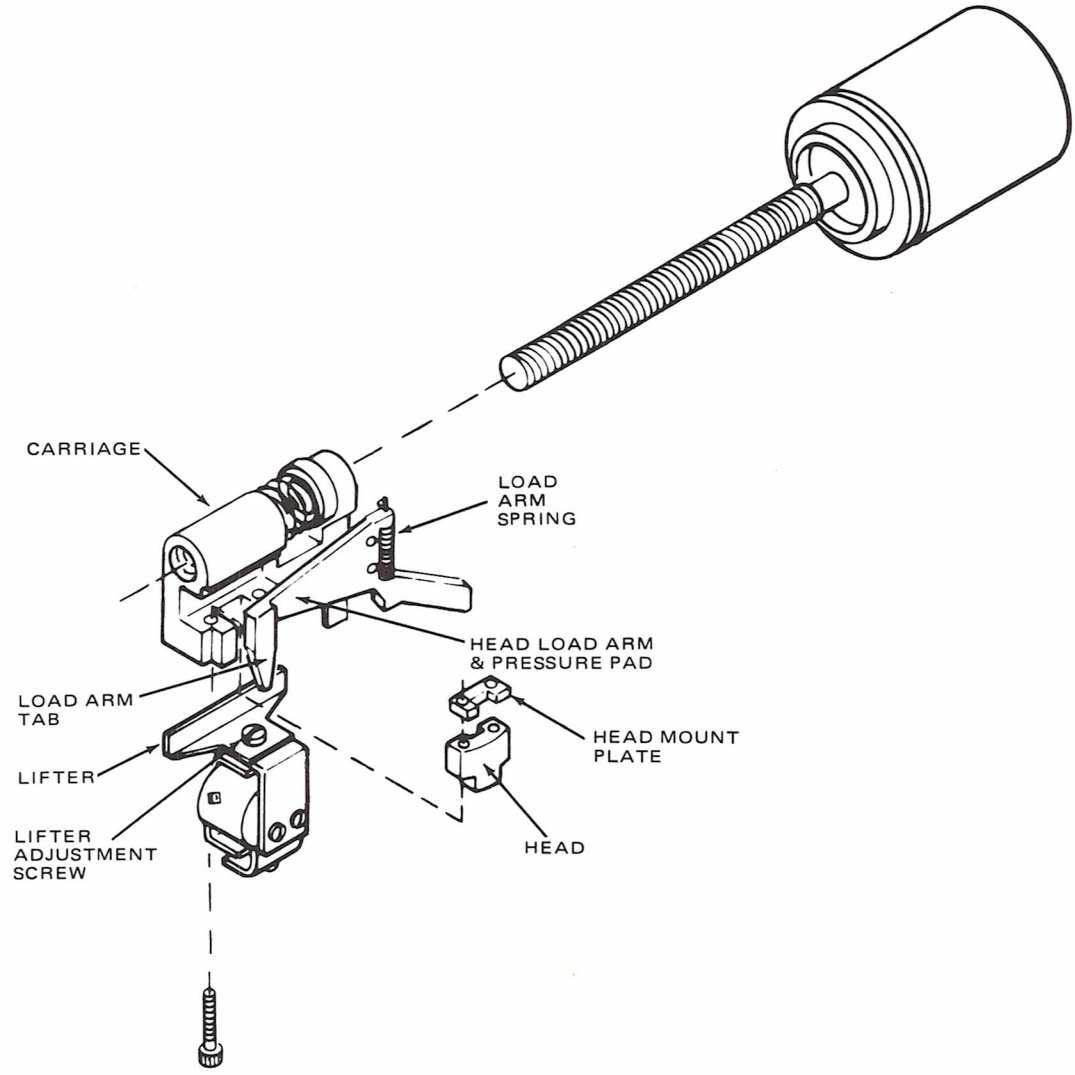


FIGURE 3-13 HEAD LOAD ACTUATOR ASSEMBLY

3-30 DOOR CLOSED SWITCH (Refer to Figure 3-15).

This is a two-position, spring-loaded switch with contacts normally open when the access door is open. When the door is closed, levers seat the loading frame such that the switch contacts close. Opening the door releases the loading frame and the contacts open. The R/W head load actuator circuits are enabled by the closed switch contacts to prevent the head from being accidently loaded when the access door is open.

3-31 Removal.

(1) Remove loading frame per paragraph 3-12.
(2) Disconnect switch electrical leads.
(3) Remove switch retaining screws and nuts.
(4) Remove switch.

3-32 Installation.

(1) Position switch on baseplate.
(2) Secure switch to baseplate using retaining screws and nuts.
(3) Connect electrical leads.
(4) Replace loading frame per paragraph 3-12.
(5) Verify that loading frame activates switch when properly seated.

3-33 DISK LOADED SWITCH (Refer to Figure 3-15).

This is a spring-loaded, lever-actuated switch with its contacts normally closed when a disk is installed in drive. With a disk properly installed, the switch contacts open which extinguished the front panel LOAD lamp.

3-34 Removal.

(1) Remove screws which secure switch to loading frame.
(2) Disconnect electrical leads from switch.
(3) Remove switch.

3-35 Installation.

(1) Secure switch to loading frame with screws removed in step 3-34 (1) above.
(2) Connect electrical leads to switch.
(3) Adjust switch physical position such that it actuates when the disk is 0.020" away from the "in" stops.

NOTE

The wire switch actuator may be bent slightly to achieve the correct adjustment.

(4) Insure that the switch is in the closed position without a disk installed and that it actuates to the open position when a disk is installed. Note that switch actuates 0.020" before the disk is fully inserted into the loading frame.

3-36 R/W HEAD CARRIAGE AND POSITIONER ASSEMBLIES.

The R/W head is mounted on a carriage that moves the head along a radial line. The carriage is driven radially by a rotating screw on which the carriage is mounted. The screw is rotated in either direction by the head position actuator. The actuator is a stepping motor that rotates the screw in 15 degree increments. The linear head travel resulting from one rotation increment is equal to the center-to-center distance between two adjacent tracks on the disk. Track accessing depends upon the initial alignment of the carriage on the screw so that the head is radially positioned over a track centerline. Carriage stops are mounted on the baseplate to prevent inadvertent carriage overtravel.

A diagnostic flow chart to assist in troubleshooting the R/W head carriage and position assemblies is shown in Figure 3-14.

3-37 R/W Head/Track Position Check.

The R/W head position is checked using the alignment tool.

(1) Remove AC power from drive after 20 minutes of running time.
(2) Position actuator to track ØØ.
(3) Insert head alignment tool (INNOVEX part #B210-8003) into loading frame and center over spindle.
(4) Clamp tool to spindle by closing access door.
(5) Ensure that the gap between the alignment tool and the R/W head reference surface is the same as the dimension (in mils.) marked on the head to the nearest 0.001". If not, perform head alignment as in section 3-38.
(6) Remove head alignment tool.

3-38 R/W Head Alignment.

(1) Remove AC and DC power from Drive after 20 minutes of running time.

(2) Rotate stepper motor shaft until carriage is at outer stop.

(3) Insert head alignment tool I(NNOVEX part #B210-8003) into loading frame and center over spindle.

(4) Clamp tool to spindle by closing access door.

(5) Loosen stepper motor mounting screws.

(6) Loosen outer carriage stop screw.

NOTE

Do not apply AC power during the following steps to prevent the Drive Motor from operating.

(7) Energize the phase 3 (Ø3) stepper motor winding. (logical 1 at TP49)

(8) Grasp the stepper motor housing and turn it as necessary until the gap between the alignment tool and the R/W head is the same as the dimension (in mils.) marked on the head. Ensure that motor is well seated in casting using stepper clamp tool No. 210-8018.

(9) Tighten stepper motor mounting screws.

(10) Open access door and remove head alignment tool and stepper clamp tool.

(11) Set outer carriage stop to .020 $\pm$ 0.005 inch from carriage and tighten screw.

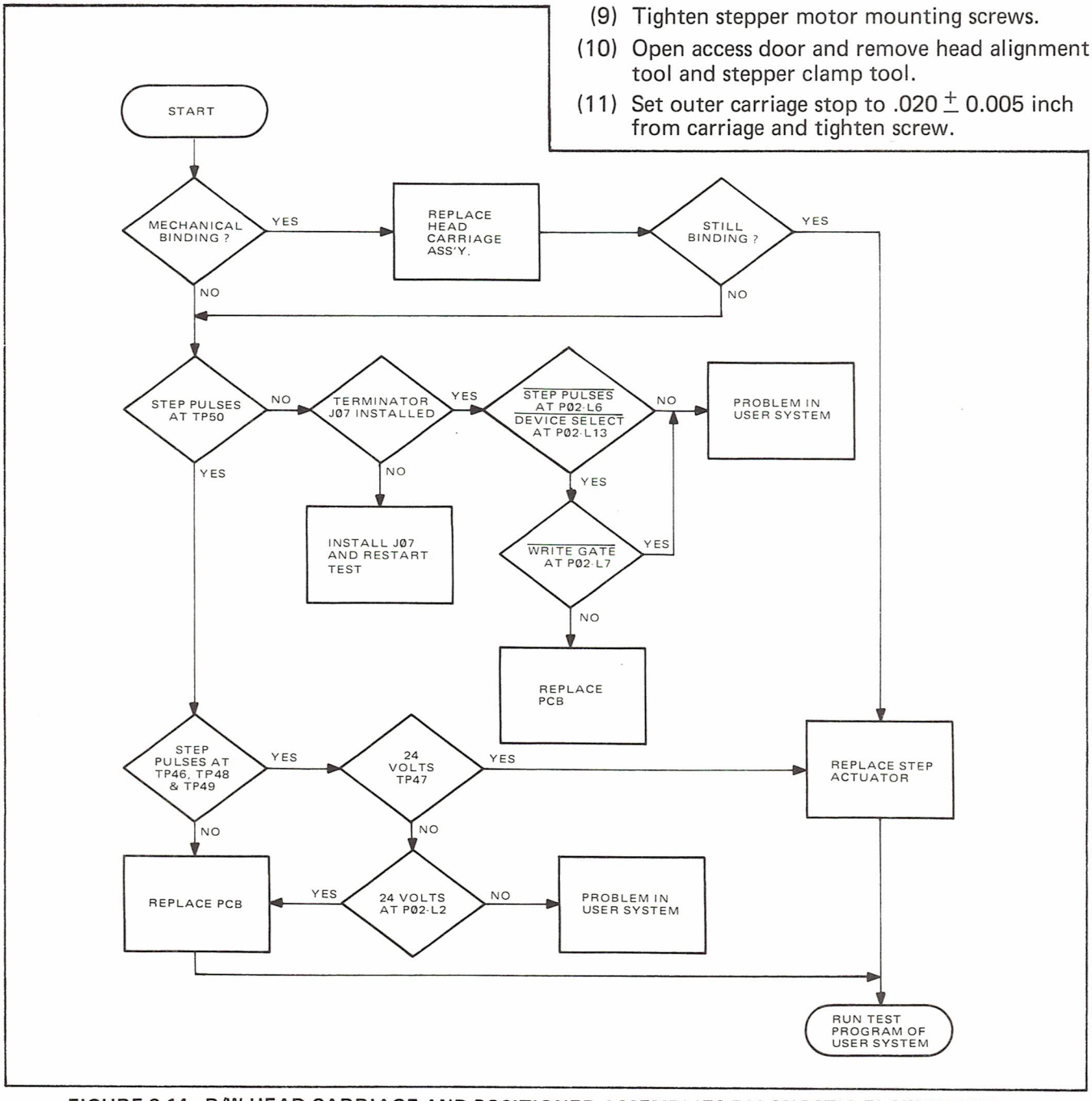


FIGURE 3-14 R/W HEAD CARRIAGE AND POSITIONER ASSEMBLIES DIAGNOSTIC FLOW CHART

3-39 CARRIAGE AND POSITIONER ASSEMBLIES

(Refer to Figure 3-13 & 3-15)

3-40 Removal

(1) Open hinged cover by releasing latch screws.

(2) Disconnect actuator leads at connector PØ5 (Refer to logic diagram D210-1264 in Section IV and Figure 3-15).

CAUTION

The head lead can be damaged by stress, crimping, or excessive flexing. To avoid damage, it must be handled with care. When removing the carriage and lead, the cable clamp location and lead routing should be noted to assure correct reinstallation.

(3) Loosen three clamp screws holding actuator cleats to baseplate.

(4) Rotate cleats to clear actuator body.

(5) Rotate actuator lead screw until it is disengaged from carriage.

(6) Remove actuator and lead screw.

(7) Remove head lead from pc board and remove lead clamp screws.

(8) Remove carriage from rail while carefully guiding R/W head lead and connector around loading frame.

3-41 Installation.

(1) Insert R/W head lead and connector around loading frame.

(2) Install carriage on rail.

(3) Insert actuator screw through baseplate access hole into unthreaded opening in carriage.

(4) Insert spring and preload nut into carriage opening and thread nut onto actuator screw.

(5) Move carriage towards actuator compressing the spring while rotating the actuator screw to thread it into threaded hole in carriage.

NOTE

Pressure exerted in step (5) establishes carriage assembly preload force. Preload force is correct when gap is less than a 1/16 of an inch and clearance exists between the nut and carriage.

(6) Position actuator on baseplate, rotate cleats and tighten screws.

(7) Connect actuator leads to connector PØ5 per Logic diagram D210-1264.

(8) Install R/W head lead clamp screws while carefully rotating lead and connector.

(9) Manually run carriage full travel and check head lead for binding.

(10) Perform R/W Head Alignment procedure per paragraph 3-38.

(11) Ensure that lifter is under head arm tab.

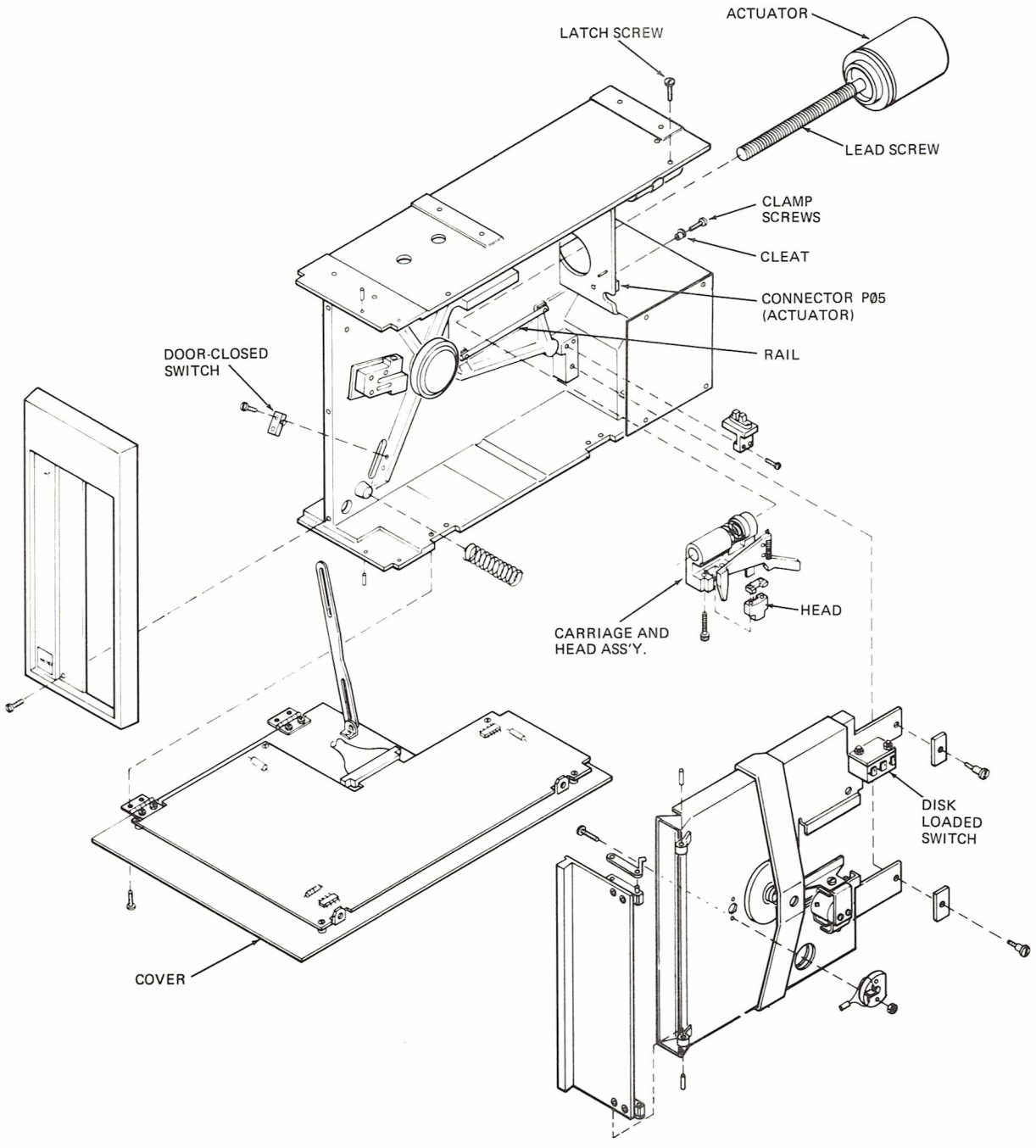


FIGURE 3-15 CARRIAGE AND POSITIONER ASSEMBLIES

3-42 TRACK ØØ DETECTOR ASSEMBLY.

(Refer to Figure 3-16).

This assembly consists of a Light Emitting Diode (LED) source and detector that generates the TRACK ØØ head position status signal. The detector is actuated by a FLAG on the carriage assembly when the carriage is in the track ØØ position. After the R/W Head Alignment, the FLAG must be positioned so that TP35 is high when the R/W head is positioned over track ØØ and is low when the R/W head is moved to track Ø2. The detector output is ANDed with the actuator motor circuit to indicate a true TRACK ØØ thus, Detector hysteresis and adjustment tolerances are not critical. Refer to Figure 3-3 for location of TP35 on pc board and logic diagram D210-2301-3 for circuit location.

3-43 Operational Checkout.

(1) At User's system, apply AC and DC power, LOAD HEAD and access TRACK ØØ.
(2) Monitor TP35 and verify that track ØØ detector is operating.
(3) Access track Ø2.
(4) Monitor TP35 and verify that detector is de-activated.
(5) If operational checkout is unsatisfactory, perform adjustment procedure described below.

3-44 Adjustment Procedure.

(1) Refer to paragraph 3-37 & 38 and perform the R/W head/track position check procedure and align if necessary.
(2) At User's system, LOAD HEAD and access track Ø1.
(3) Loosen two retaining screws on flag.
(4) Slide flag to rear until detector is de-activated. (logical Ø at TP35)
(5) Slowly slide flag to front until signal at TP35 changes to a logical 1.
(6) Tighten flag retaining screws while holding flag in activated position.
(7) Access track Ø2 and verify that detector is de-activated.
(8) Refer to paragraph 3-42 and perform track ØØ detector operational checkout.

3-45 Removal.

(1) Disconnect sensor leads from detector assembly.
(2) Remove retaining screws from bracket.
(3) Remove bracket and detector assembly.

3-46 Installation.

(1) Position bracket and detector assembly on baseplate.
(2) Secure bracket with retaining screws.
(3) Connect sensor leads to detector assembly per logic diagram D210-1264 in Section IV.
(4) Perform track ØØ adjustment procedure described in paragraph 3-43.

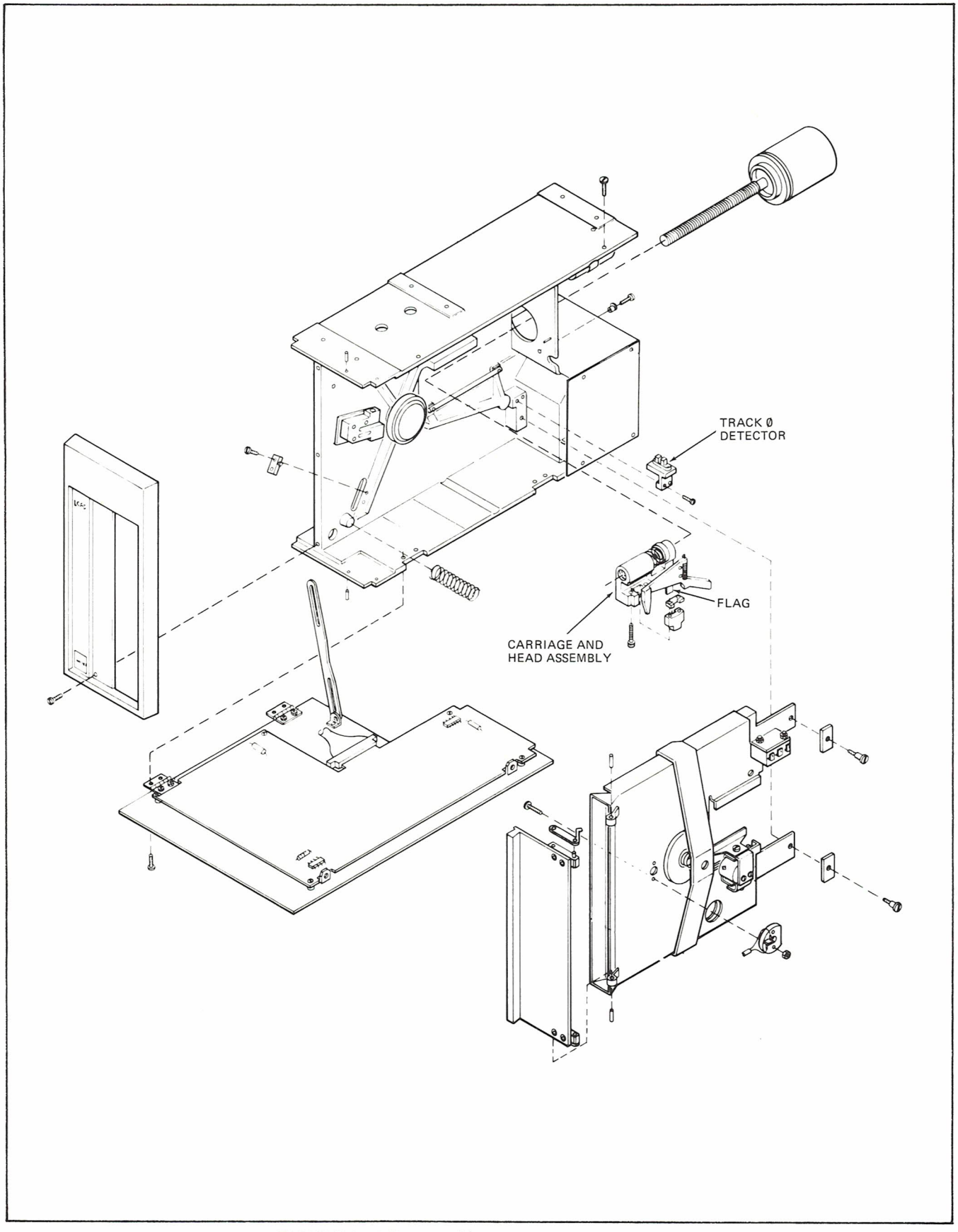


FIGURE 3-16 TRACK ØØ DETECTOR ASSEMBLY

3-47 DRIVE MOTOR ASSEMBLY (See Figure 3-17)

This is a constant speed AC motor which drives the disk. It is supplied for either 110 VAC operation with input power provided by the User's system. The motor operates whenever the required voltage is present across terminals 1, 2 and 3 of connector PØ4 (Refer to logic diagram D210-1264 in Section IV).

3-48 Removal.

(1) At User's system, remove AC power from Model 210 Drive.
(2) Remove filter cover and filter.
(3) Remove belt from pulleys.
(4) Remove two screws from connector bracket but do not disassemble connector from bracket.
(5) Remove motor capacitor strap by removing strap retaining screws.
(6) Remove impeller cover, impeller and cable clamp.
(7) Remove four screws securing motor to baseplate and remove motor assembly with wires and pulley attached.

3-49 Installation.

(1) Position motor assembly on baseplate by inserting motor shaft with attached pulley through baseplate access hole.
(2) Secure motor to baseplate with four screws.
(3) Install belt on pulleys.
(4) Install air filter cover, impeller cover, impeller and cable clamp.
(5) Position motor capacitor and secure capacitor strap with retaining screws. (Refer to diagram D210-1264 for wiring).
(6) Position connector bracket with attached connector and secure to baseplate with two bracket screws.

3-50 MOTOR PULLEY.

The motor drive pulley must be changed for 50 or 60 Hz operation as described below.

3-51 Removal.

(1) Remove filter cover.
(2) Loosen set screw in motor pulley.
(3) Slide pulley off motor shaft.

3-52 Installation.

(1) Determine frequency of drive motor AC power (either 50 or 60 Hz).
(2) Slide correct size pulley onto motor shaft.
(3) Align motor pulley with spindle pulley flush with end of motor shaft.
(4) Tighten set screw in motor pulley.
(5) Replace filter cover.

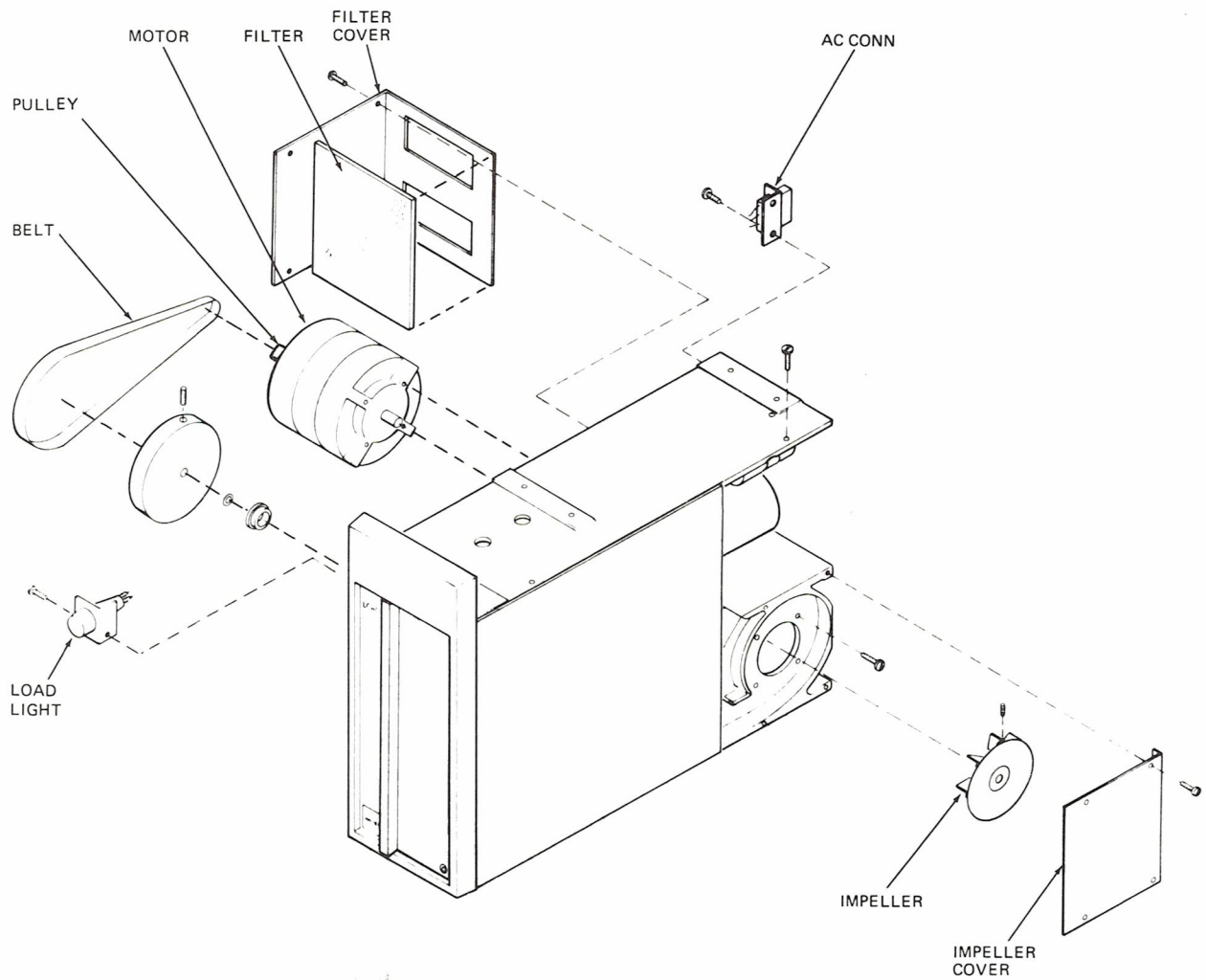


FIGURE 3-17 DRIVE MOTOR ASSEMBLY

3-53 INDEX SENSING CIRCUITS
(See Figure 3-18).

Components for sensing the index hole in the disk consist of a Light Emitting Diode (LED) mounted on the front of the loading frame and a photo transistor detector mounted behind the loading frame. The line of sight between these two components is perpendicular to the disk plane and intersects the disk at the circle formed by the index hole. When the disk is spinning infrared light emitted by the LED activates the photo transistor which generates a 5-volt pulse each time the index hole passes by. An adjusting screw is provided to position the photo transistor along the arc of the index hole such that the leading edge of the index pulse coincides with R/W head and the geometric index radius of the disk. Alignment is done with INNOVEX alignment tool part number B210-8003.

3-54 Operational Checkout.

(1) Access track ØØ.
(2) Refer to paragraph 3-38 and perform R/W head alignment.
(3) With alignment tool in alignment position, verify that voltage at test point TP38 is 3.5V $\pm$ 0.5V.
(4) Remove alignment tool.

3-55 Alignment Procedure.

(1) If operational checkout is unsatisfactory, repeat R/W head alignment described in paragraph 3-38 and leave alignment tool in alignment position.

CAUTION

Do not apply AC power during this procedure.

(2) Connect probe of oscilloscope to test point TP38 and set scope to AUTO trigger.
(3) Position screw driver through baseplate access hole and rotate detector shaft as necessary until voltage at TP38 is +3.5V $\pm$ 0.5V.
(4) Disconnect scope and remove alignment tool.

3-56 LED Assembly Removal.

(1) Remove Loading Frame from drive. (Section 3-12).
(2) Remove two LED mounting screws.
(3) Remove LED assembly.

3-57 LED Assembly Installation.

(1) Position assembly on Loading Frame.
(2) Secure assembly using two mounting screws.
(3) Replace Loading Frame in drive, as described in section 3-13. (Refer to drawing D210-1264 in Section IV).

3-58 Photo Transistor Assembly Removal.

(1) Refer to paragraph 3-12 and remove loading frame.
(2) Disconnect harness leads from photo transistor assembly.
(3) Remove three mounting screws.
(4) Remove photo transistor assembly.

3-59 Photo Transistor Assembly Installation.

(1) Position assembly on baseplate.
(2) Secure assembly using three mounting screws.
(3) Connect harness leads to photo transistor assembly per drawing D210-1264.
(4) Refer to paragraph 3-54 and perform index alignment procedure.

NOTE

Figure 3-19 is a diagnostic flow chart for troubleshooting the index sensing circuits when no pulses are present and Figure 3-20 is a diagnostic flow chart for troubleshooting index timing problems.

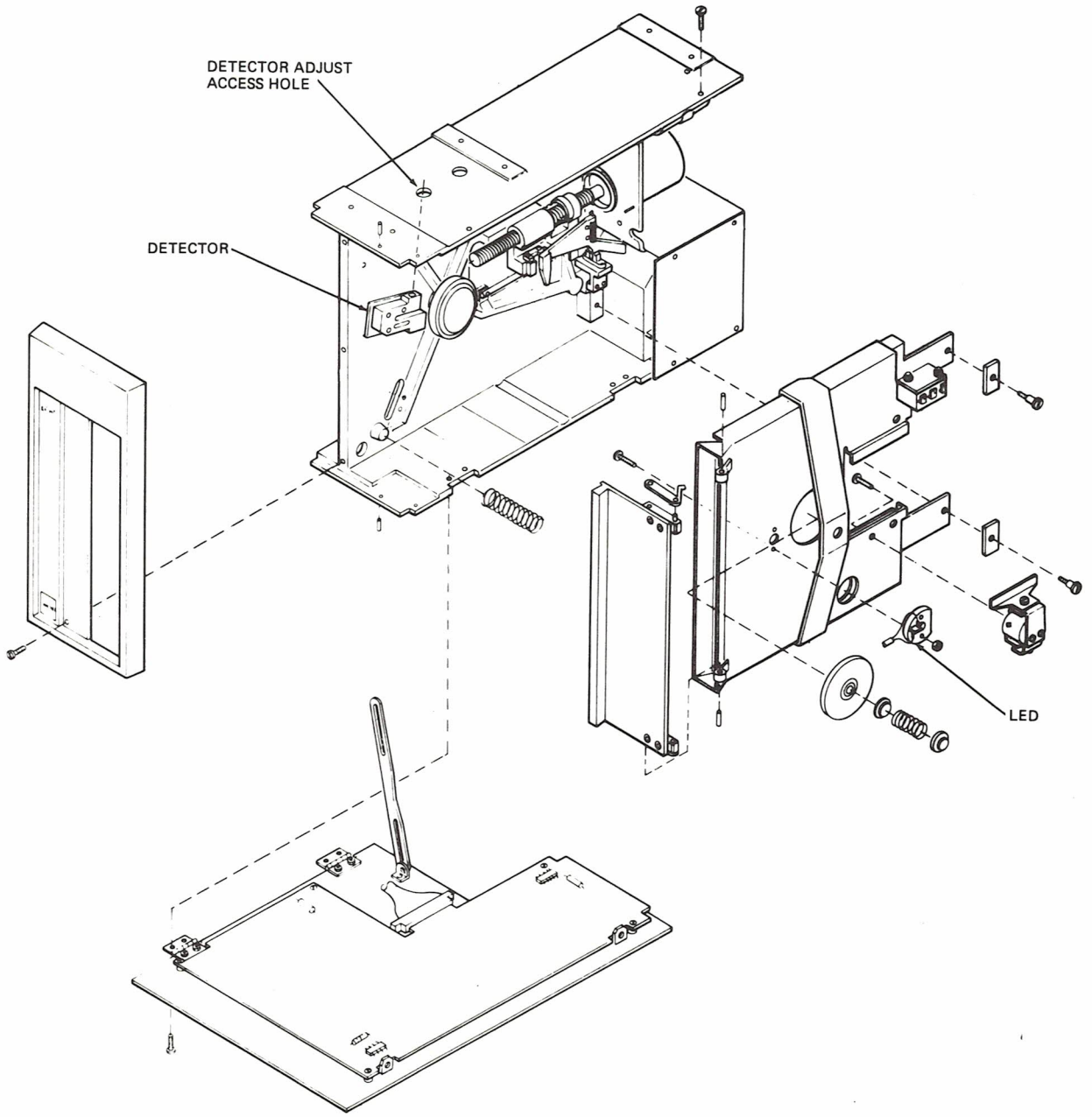


FIGURE 3-18 INDEX COMPONENTS

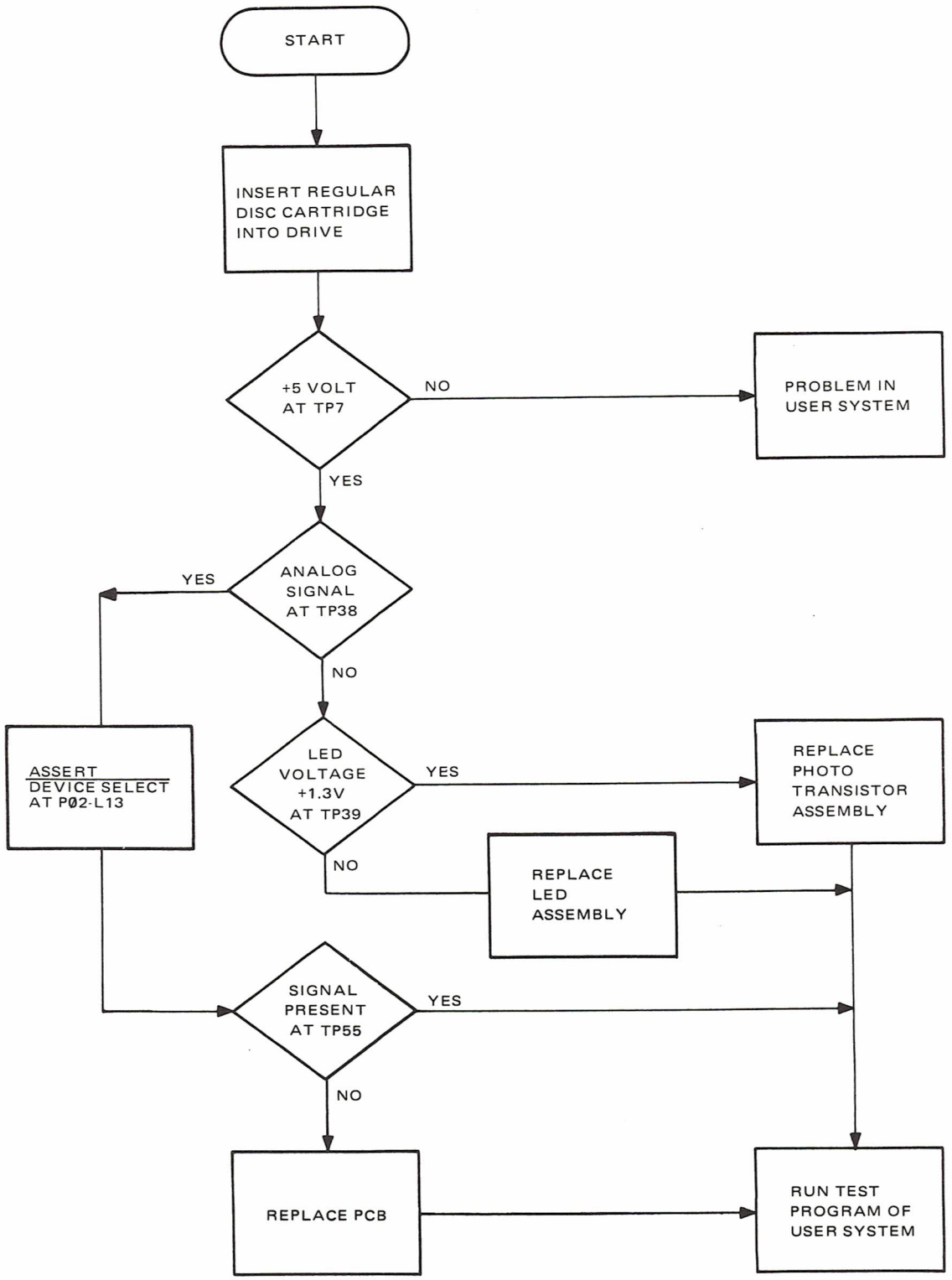


FIGURE 3-19 INDEX SENSING CIRCUITS DIAGNOSTIC FLOW CHART

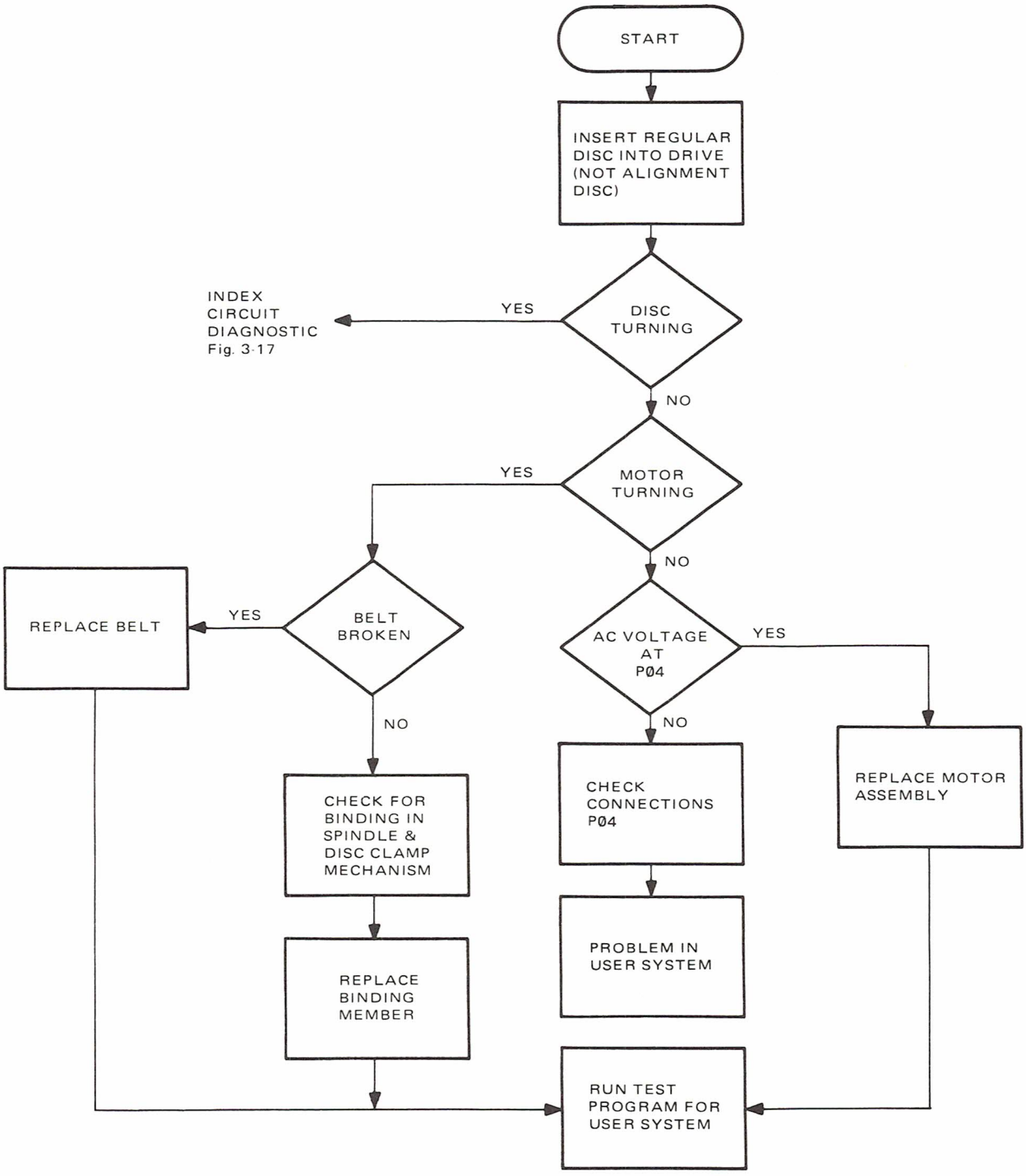


FIGURE 3-20 INDEX TIMING DIAGNOSTIC FLOW CHART

3-60 Sector Sensing Circuits. (Model 220 Series only) See Figure 3-18.

The components used for sensing the sector holes in the disk are the same as those used for index, see Section 3-53. See Figures 3-21 and 3-22 for diagnostic signals and flow chart.

3-61 Operational Checkout.

Same as Section 3-54.

3-62 Alignment Procedure.

Same as Section 3-55.

3-63 LED Assembly and Photo Transistor Assembly Removal and Installation.

Same as Sections 3-56 through 3-59.

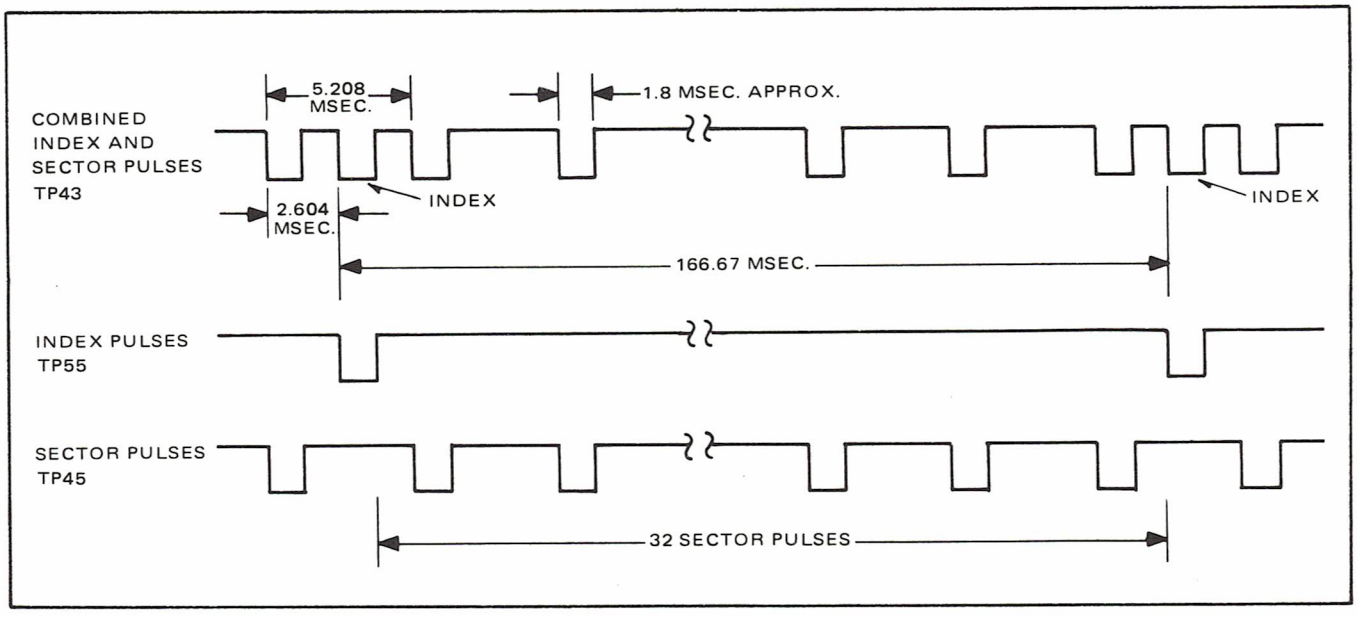


FIGURE 3-21 SECTOR TIMING DIAGRAM

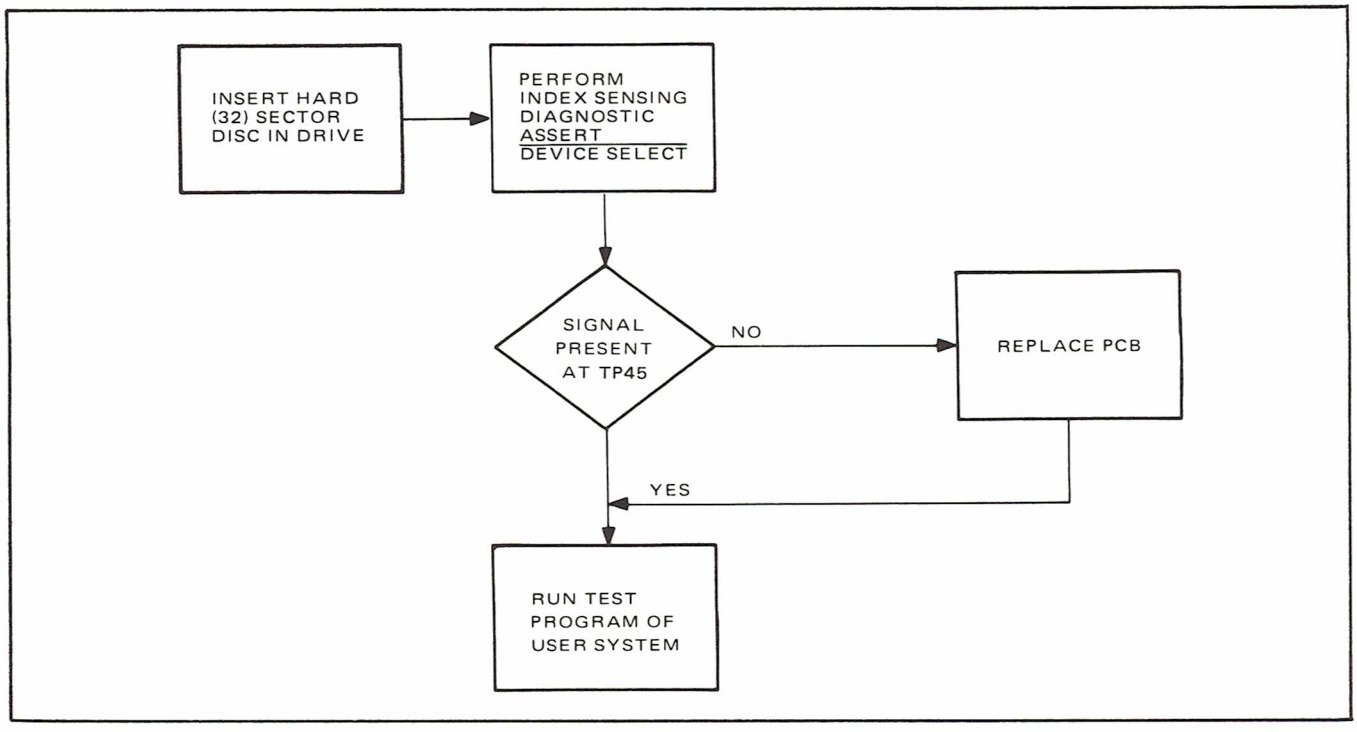


FIGURE 3-22 SECTOR SENSING CIRCUITS DIAGNOSTIC FLOW CHART

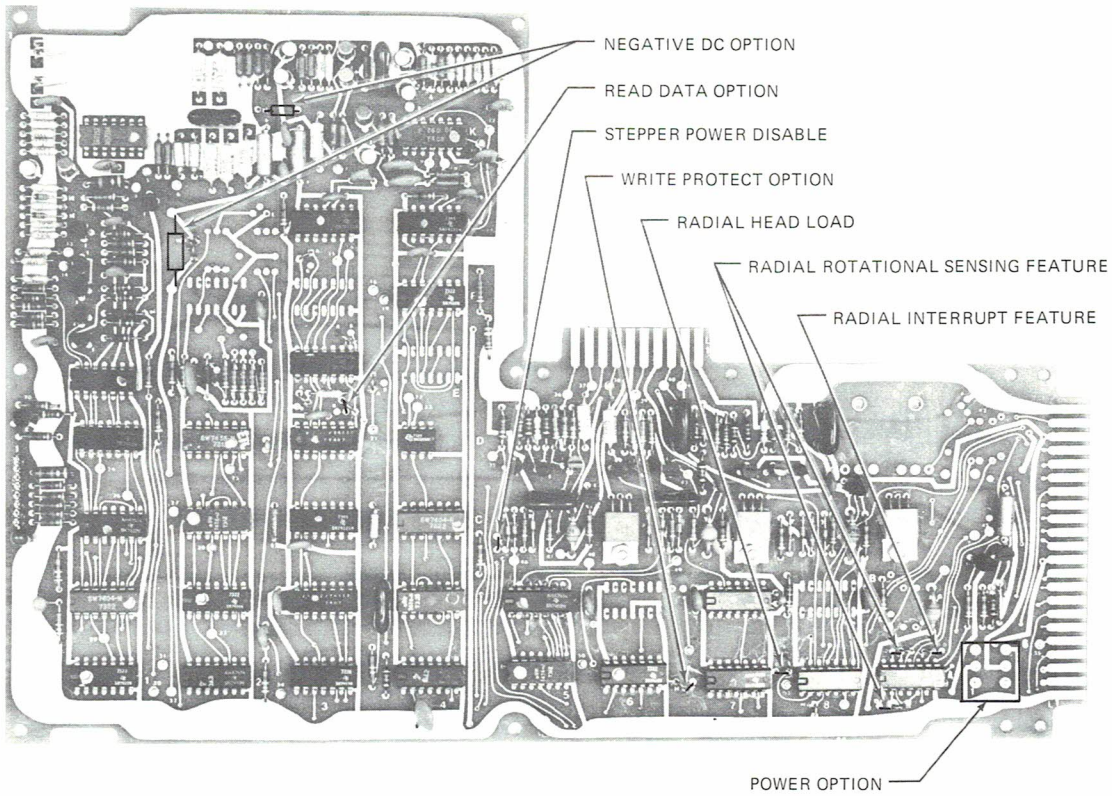


FIGURE 3-23 ELECTRONIC PC BOARD OPTIONS

3-64 POWER OPTION

The installation of the header assembly AMP P/N 1-380999-0 (See Figure 3-23) will allow the radial distribution of DC power via this connector, rather than via the finger contacts of PØ2.

3-65 RADIAL INTERRUPT FEATURE (Ungated Ready)

The installation of link D (See Figure 3-23) will disable the device select signal to the Ready Line driver, allowing the Ready signal to be present at all times. If this feature is not required link E must be installed.

3-66 RADIAL ROTATIONAL SENSING (Ungated Index and Sector)

The installation of the two D links (See Figure 3-23) will disable the device select signal to the Index and Sector line drivers, allowing the Index and Sector (Model 220 only) pulses to be placed on the interface whenever detected. If this feature is not required the two E links must be installed.

3-67 RADIAL HEAD LOAD FEATURE (Ungated Head Load)

The installation of link D (See Figure 3-23) will disable the device select signal to the Head Load receiver permitting the Head to be loaded whenever the -Head Load line is asserted and the door closed. If this feature is not required, link E must be installed.

3-68 NEGATIVE DC SUPPLY VOLTAGE FEATURE

When this option is required the -5VDC is derived from the -12V or -15V by means of resistor R104 and Zener diode CR8. If this option is not required link W1 must be installed (See Figure 3-23).

CAUTION

W1 must not be installed when using the -12V or -15V supply voltages.

3-69 READ DATA OPTION

The installation of link C (See Figure 3-23) will disable the data separator input to the SEPARATED DATA line driver and the unseparated or raw data will now be transmitted over the SEPARATED DATA line L17 on PØ2.

The SEPARATED CLOCK will be unchanged and the clock pulses will still be transmitted over this line. If this option is not required the A link must be installed.

3-70 WRITE PROTECT OPTION

When the hardware Write Protect option is installed, link F must be inserted in order to enable the Write Protect line driver and file unsafe circuitry. If this option is not required, link H must be installed.

3-71 WRITE PROTECT SENSING CIRCUIT (See Figure 3-11)

This assembly consists of a Light Emitting Diode (LED) source and detector, mounted on the loading frame. The line of sight between these two components is perpendicular to the diskette plane and intersects the Diskette jacket at the co-ordinates given in figure 1-2. The detector is actuated by infrared light emitted by the LED passing through the Write Protect Sensing hole in the diskette jacket. Attempting a write operation on a protected Diskette will result in a File Unsafe condition.

3-72 OPERATIONAL CHECKOUT

(1) At User's system apply DC power.

(2) Monitor TP53 and verify that the detector is activated (logical 1) with a Write Protected Diskette fully inserted.

(3) Insert an unprotected Diskette and verify that the sensor is deactivated (TP53 is a logical 0)

3-73 Removal

(1) Disconnect leads from detector assembly.

(2) Remove retaining screws from bracket.

(3) Remove bracket and detector assembly.

3-74 Installation

(1) Position bracket and detector assembly on frame.

(2) Secure bracket with retaining screws.

(3) Connect sensor leads to detector assembly per logic diagram D210-1264.

(4) Perform operational check per paragraph 3-72.

3-75 STEPPER POWER DISABLE OPTION

The installation of link E (See Figure 3-23) will logically AND the device select signal with the inputs to the stepper motor phase drivers, permitting all drivers to be in the off state whenever the device is not selected. If this option is not required, link E must be removed.

3-76 INTERLOCK

The interlock consists of a solenoid assembly and a spring loaded shaft which passes thru the baseplate preventing the loading frame and door from closing unless the solenoid is energized when the Diskette Loaded Switch is made. A manual override passes thru the bezel to allow closing of the door with power off or with no Diskette inserted.

3-77 Removal

(1) Remove loading frame, refer to paragraph 3-12.

(2) Remove interlock shaft and spring.

(3) Remove solenoid leads.

(4) Remove retaining screws from solenoid block and slide block from release pin.

(5) Remove retaining screws from solenoid assembly.

(6) Remove solenoid assembly.

(7) Remove interlock spring and retaining washer from solenoid plunger.

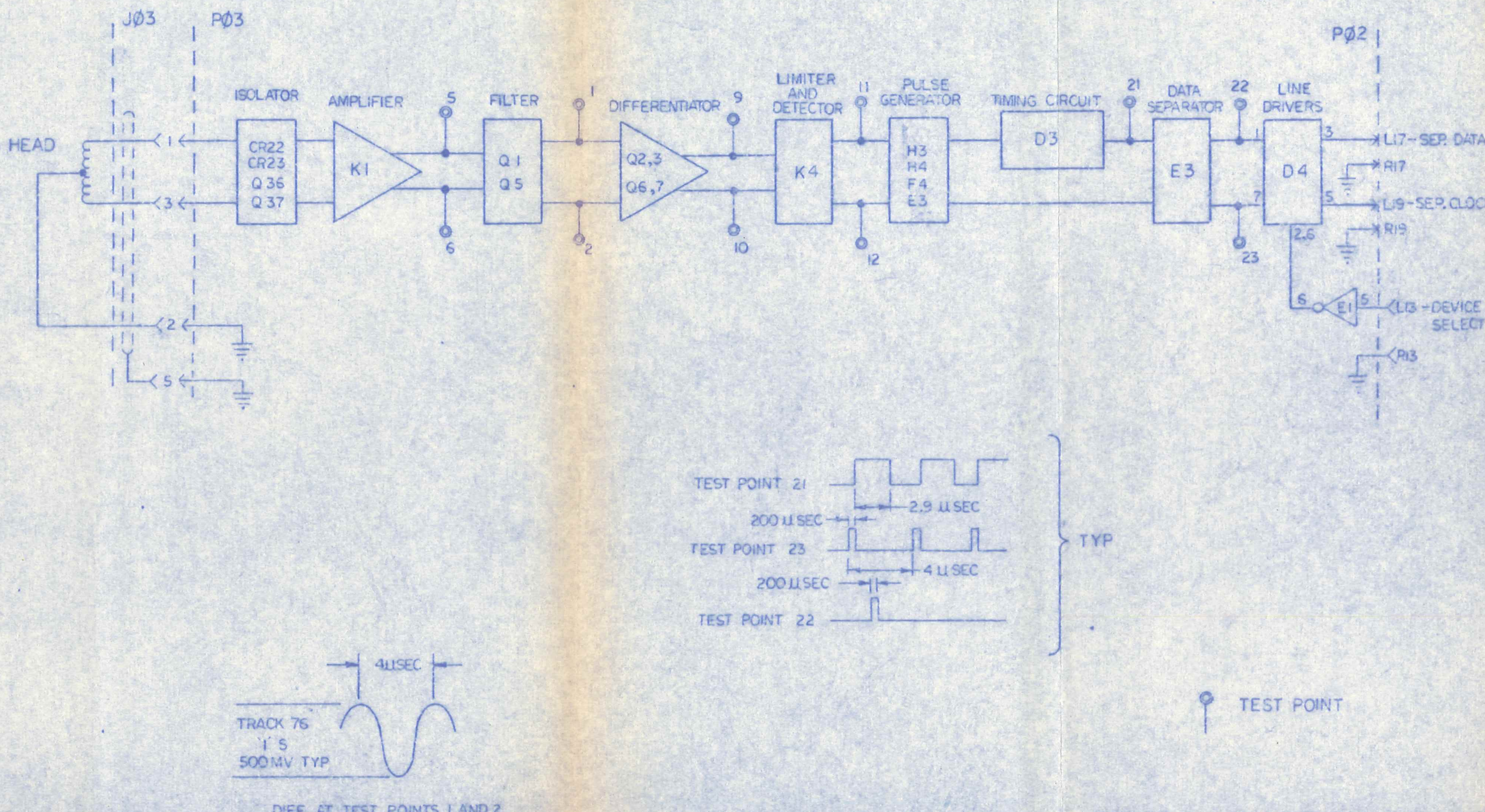
3-78 Installation

(1) To install interlock assembly, reverse removal procedures of paragraph 3-77.

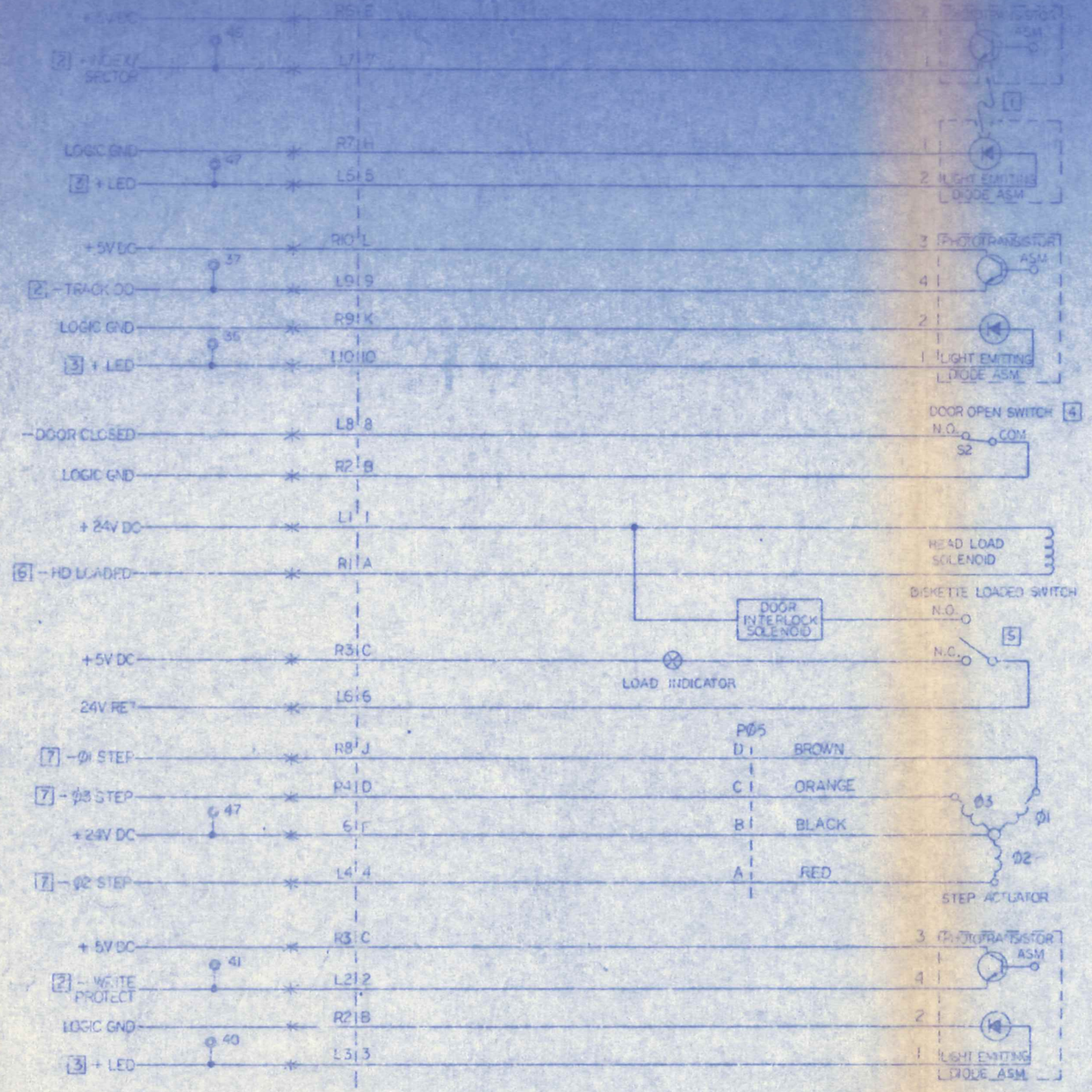
(2) Connect solenoid leads per logic diagram D210-1264.

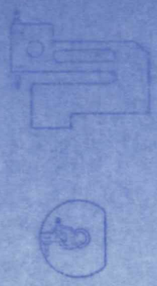
(3) Check interlock manually to insure there is no binding in the interlock shaft.

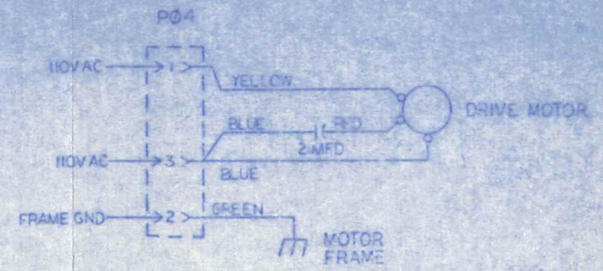
SECTION IV
DRAWINGS



TOLERANCES (EXCEPT AS NOTED)	INNOVEX BEDFORD, MASS.		
DECIMAL ±		SCALE	DRAWN BY / APPROVED BY
FRACTIONAL ±	TITLE 200 SERIES – MULTIPLEX INTERFACE READ CIRUIT		
ANGULAR ±	DATE 7 NOV. 74	DRAWING NUMBER 0210-1263	REV. A





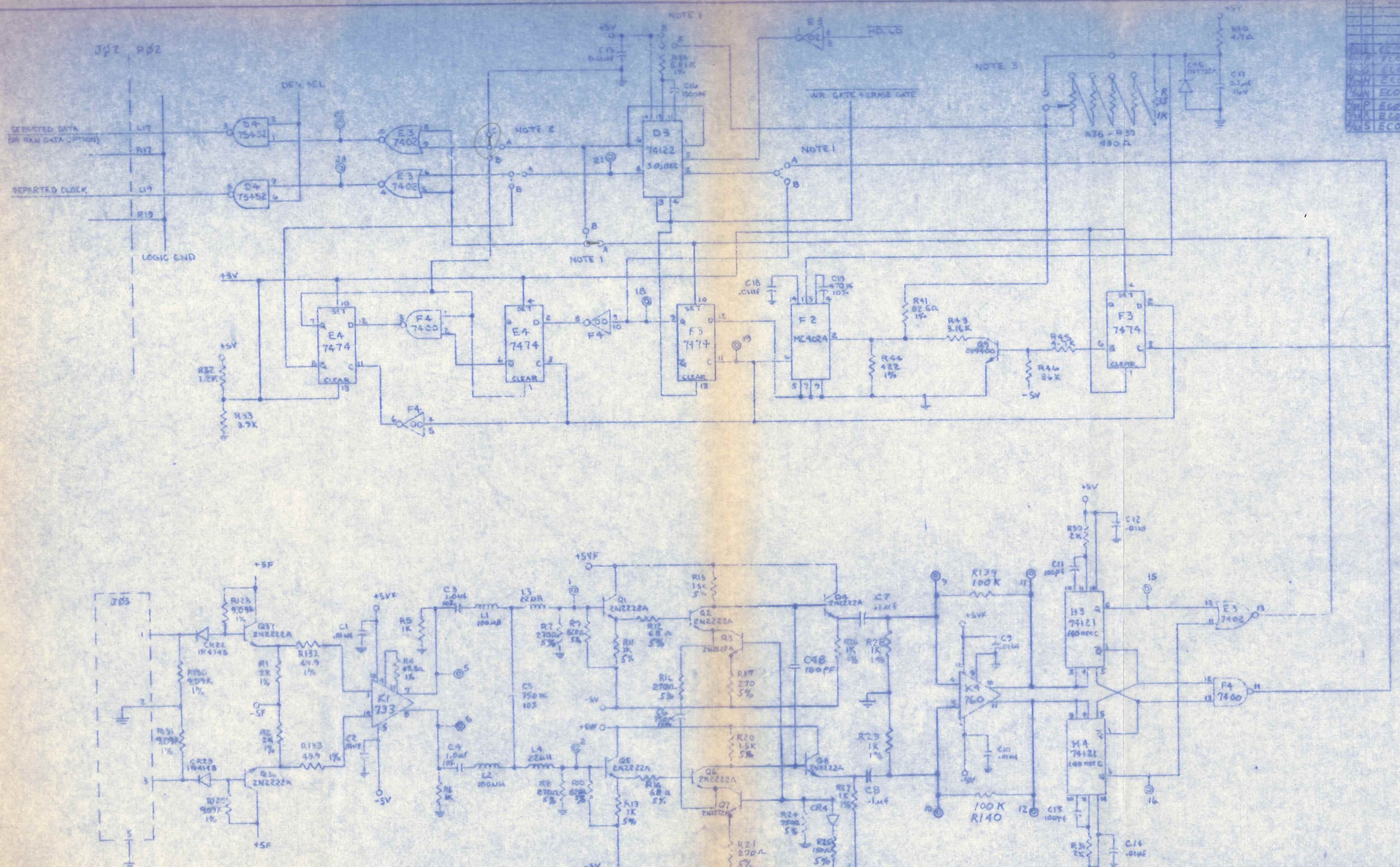


NOTES:

1. OPTICAL COUPLING LIGHT IS AT 9000 ANGSTROMS WAVELENGHTH AND IS NOT VISIBLE.
2. ANALOG SIGNAL APPROXIMATELY 3 VOLTS PEAK.
3. DC VOLAGE APPROXIMATELY + 1.3 VOLTS.
4. SWITCH SHOWN WITH DOOR CLOSED.
5. SWITCH SHOWN WITH DISKETTE LOADED.
6. +24V DC FALSE, 0.4V DC TRUE.
7. +24V DC FALSE, +1V DC TRUE.

TEST POINT

	ENDOTEX
	200 SERIES - MULTIPLEX INTERFACE INTERNAL CABLE/DRIVE MOTOR CONN.
	D210-1264 REV B



NOTES:
1. LINK B FOR PHASE LOCKED CLOCK, OTHERWISE LINK A
2. LINK C FOR RAW DATA OPTION (OPTION 007), OTHERWISE AS NOTE 1
3. PHASE LOCKED LOOP OPTION 006 R35: 100 Ω POTENTIOMETER, DELETE R36 - R39
4. UNLESS OTHERWISE SPEC. ALL RES. 1/4W 5%
5. R130, R131: 10K 1/4W 5% RES. FOR-001 BOARDS
3.9K 1/4W 5% RES. FOR-002 BOARDS

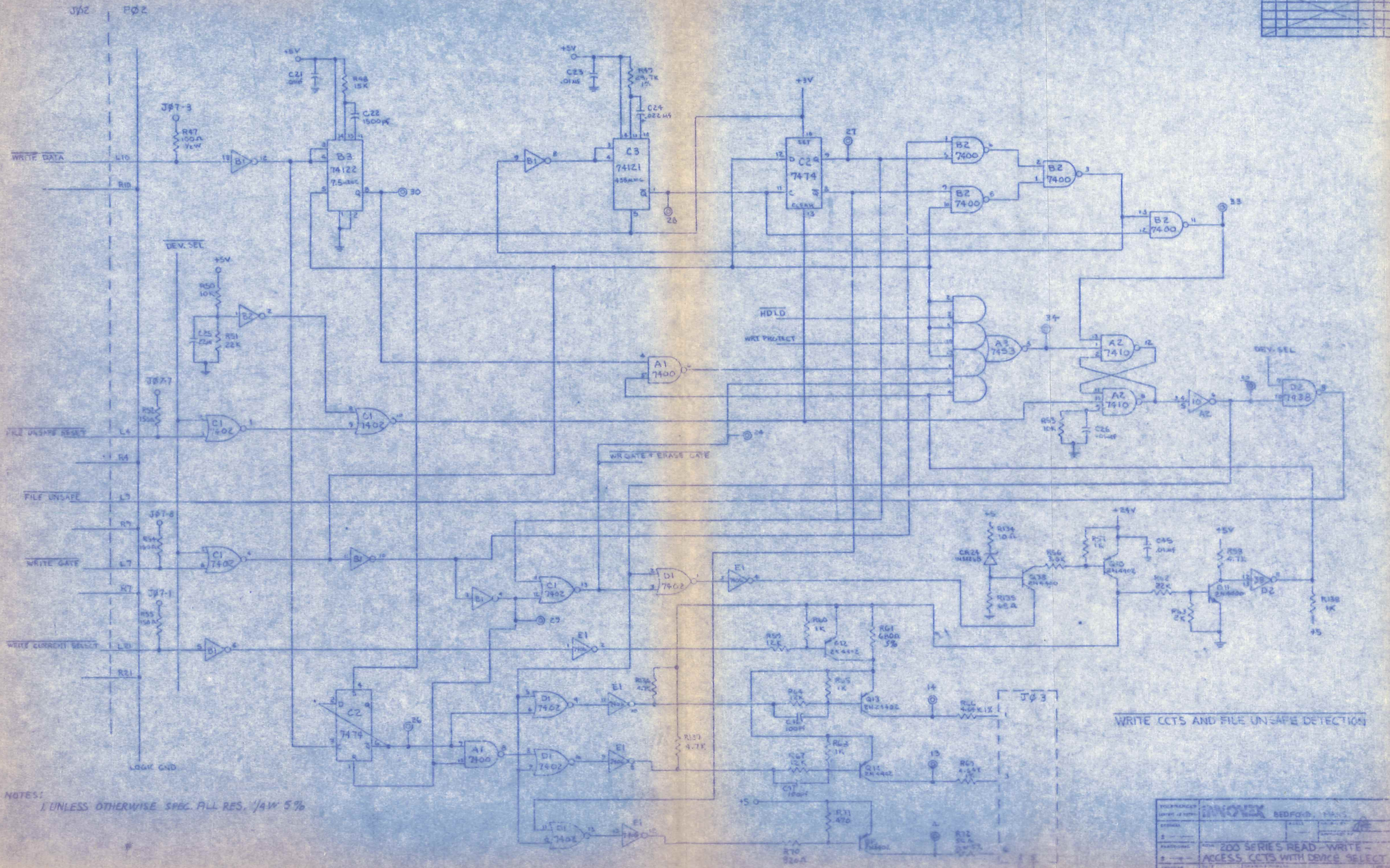
READ CCTS AND DATA SEPARATION

REV	DESCRIPTION		
E	ECO# 1223		
F	ECO # 1232		
G	ECO # 1233		
H	ECO # 1245		JC
N	ECO # 1250		JC
P	ECO # 1253		JC
R	ECO # 1255	KW	JC
S	ECO # 1256	RW	DC

BEDFORD MASS.

TITLE: 200 SERIES READ-WRITE-ACCESS CCTS WITH DEVICE SELECT

DATE: 21 OCT 74 | D210-2301 | SHT 1 OF 4 | REV S



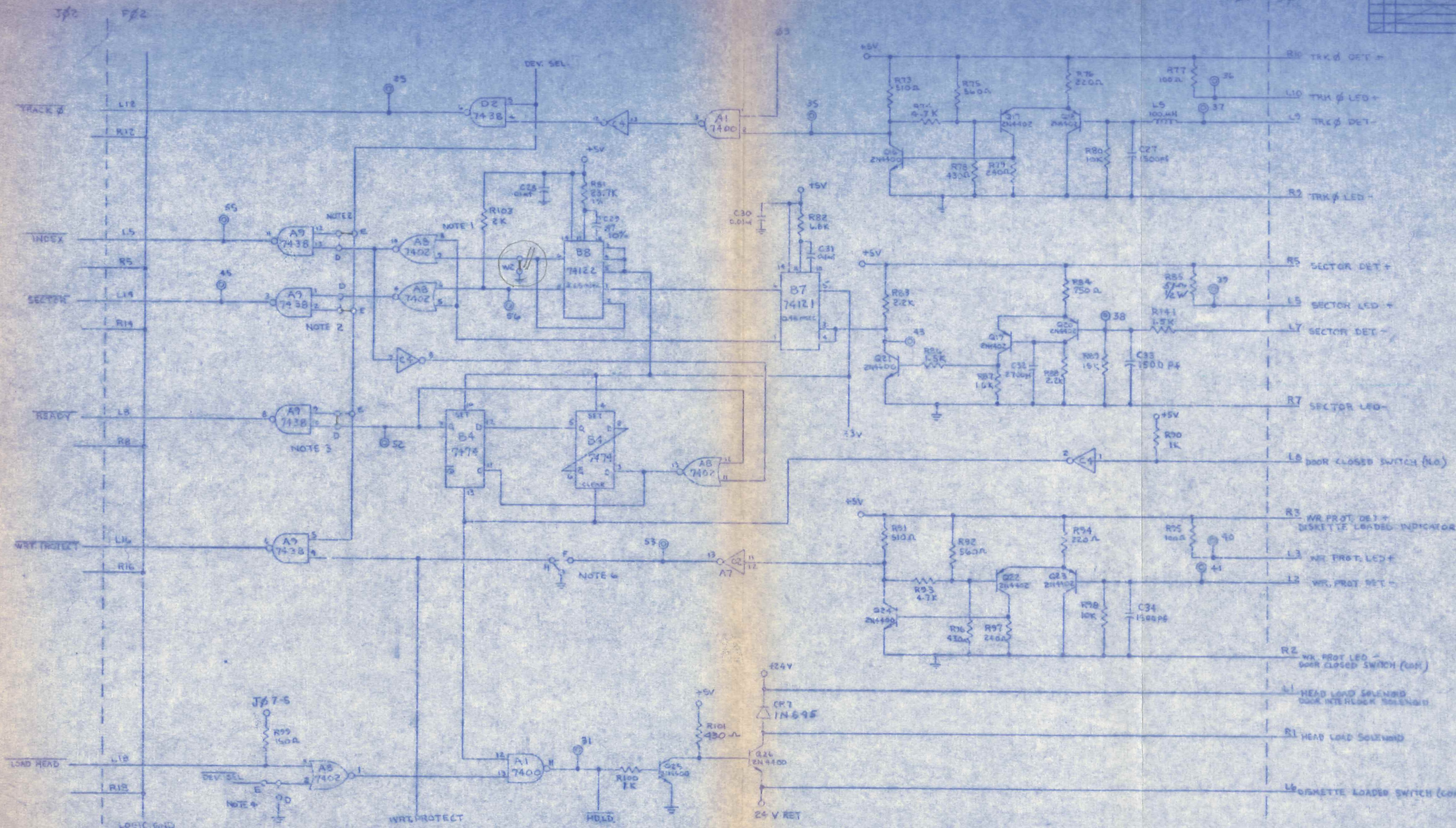
NOTES:

1. UNLESS OTHERWISE SPEC. ALL RES. 1/4W 5%

INNOVEX BEDFORD, MASS

200 SERIES READ - WRITE - ACCESS CCTS WITH DEVICE SELECT

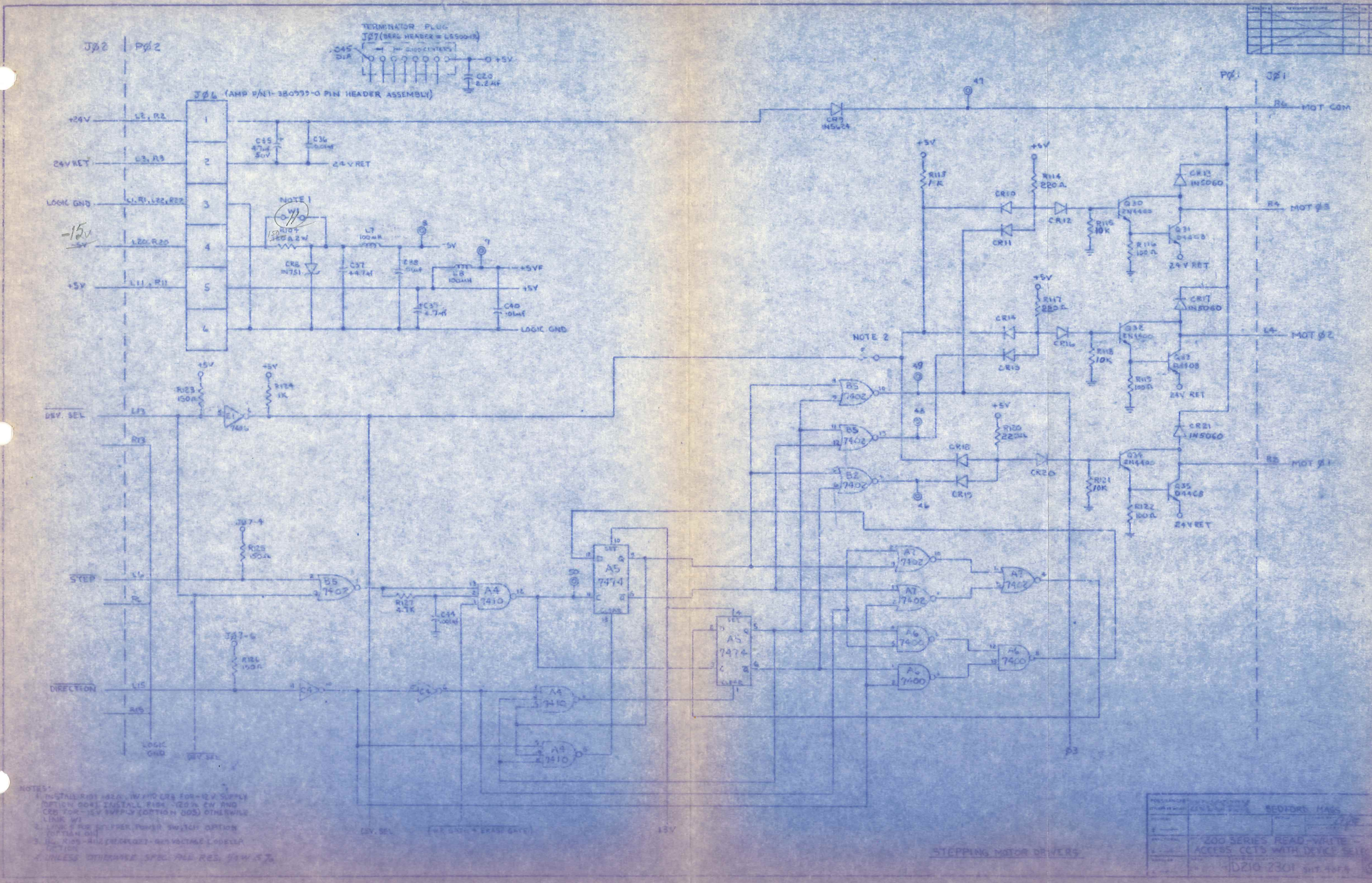
29 OCT 74 D210-2301 SH: 2 OF 4 REV 5



NOTES:
1. INSTALL B8, R103 AND C29 FOR HARD SECTOR (OPTION 003) OTHERWISE INSTALL LINK W2
2. LINK D FOR RADIAL ROTATION SENSING FEATURE (OPTION 008) OTHERWISE LINK E
3. LINK D FOR RADIAL INTERRUPT FEATURE (OPTION 009) OTHERWISE LINK E
4. LINK D FOR RADIAL HEAD LOAD FEATURE (OPTION 010) OTHERWISE LINK E
5. INSTALL LINK F FOR WRITE PROTECT OPTION (OPTION 012)
6. UNLESS OTHERWISE SPEC. ALL RES. 1/4 W 5%

INTERLOCK

TOLERANCES (EXCEPT AS NOTED)	BEDFORD, MASS
DECIMAL ±	DRAWN BY
FRACTIONAL ±	TITLE 200 SERIES READ - WRITE - ACCESS CCTS WITH DEVICE SELECT
ANGULAR ±	DATE 21 OCT 7? · DRAWING NUMBER DZ10-2301 SHT. 3 OF 4 · REV C


JØ2
PØ2
TERMINATOR PLUG
JØ7
.045 DIA
+5V
C20
JØ6 (AMP P/N 1-380999-0 PIN HEADER ASSEMBLY)
+24V
24V RET
LOGIC GND
-15V
+5V
NOTE 1
W1
CR8
IN751
C37
L7
L8
+5VF
C39
C40
CR9
IN5624
PØ1
JØ1
MOT COM
MOT Ø3
MOT Ø2
MOT Ø1
CR13
IN5060
CR17
IN5060
CR21
IN5060
Q30
Q31
Q32
Q33
Q34
Q35
D44C8
24V RET
R113
R114
R115
R116
R117
R118
R119
R120
R121
R122
CR10
CR11
CR12
CR14
CR15
CR16
CR18
CR19
CR20
NOTE 2
DEV. SEL
R123
150Ω
R124
1K
7406
B5
7402
B2
A7
A6
7400
A5
7474
A4
7410
STEP
JØ7-4
R125
150Ω
R127
4.7K
C44
JØ7-6
R126
150Ω
DIRECTION
LOGIC GND
STEPPING MOTOR DRIVERS
NOTES:
1. INSTALL R103 82Ω, 1W AND CR8 FOR -12V SUPPLY (OPTION 004) INSTALL R104 120Ω 2W AND CR8 FOR -15V SUPPLY (OPTION 005) OTHERWISE LINK W1
2. LINK F FOR STEPPER POWER SWITCH OPTION (OPTION 011)
3. R103-R112 (R108, R107) - 025 VOLTAGE LOOSELP OPTION
4. UNLESS OTHERWISE SPEC. ALL RES. 1/4W 5%
BEDFORD MASS
200 SERIES READ-WRITE ACCESS CCTS WITH DEVICE SEL
D210 2301
SHT. 4 OF 4
G